FOUNDRY TRADE JOURNAL

Established 1902

Vol. 97 Thursday, July 15, 1954 No. 1976

PRINCIPAL CONTENTS

	PAGE
Features	
Leader: Post-graduate Training	59
Conference Paper Authors	60
New Catalogues	68
Technical	
Correlation of the Properties of Castings and Test-bars in Grey Cast Iron, by E. O. Lissell and M. Itzel	61
High-pressure Moulding in America, by B. H. C. Waters, M.A., Ph.D.	67
Report of sub-committee T.S. 43—Cupola Developments	69
News	
Edward Williams Lecture Appreciation	60
Graduate Course in Metallurgy	66
Standardization of Pallets	68
More Accident Cases	76
Meehanite Research Conference	76
B.C.I.R.A. Open Day	77
Personal and Obituary	78
News in Brief	79
Raw Material Markets	84
Statistics	
Imports and Exports of Iron and Steel in May ...	82
Current Prices of Iron, Steel and Non-ferrous Metals (Advert. section)	32

PUBLISHED WEEKLY: Single Copy, 9d. By Post 11d. Annual Subscription, Home 40s. Abroad 45s. (Prepaid).

49 Wellington Street, London, W.C.2. 'Phone: Temple Bar 3951 (Private Branch Exchange) Grams: "Zacatecas, Rand, London"

Post-graduate Training

It is now some four years since a research committee of the Federation of British Industries announced that if the manufacturing concerns of this country were to increase or indeed maintain their hold on the export market, they would need to have on their staff more technologists of a higher calibre than at present available. The main source of supply was said to be the universities, and to meet the necessity it was obviously desirable that these bodies should create post-graduate courses for graduates—or men of similar scientific standing—who had worked in industry for a few years. This was taken up by the University Grants Committee and a number of courses were inaugurated.

In 1950, the University of Birmingham became the centre for process metallurgy and since that time there has passed through its magnificently equipped laboratories a steady stream of highly qualified metallurgists eminently suited for exacting executive positions in industry. It is obviously a strain on any organization—be it large or small, for the former are divided into virtually water-tight compartments—to allow a trained member of the scientific staff to leave its employ for a whole year, even though there be every chance that the organization will be better served in the future. However, in such cases there must be instituted a long-term policy, and where, say, six high-grade men are presently employed, their number must be augmented so that one can be given leave of absence to attend the course. We are assured that the firms which have sponsored students have been pleased to note on their return not only enhanced professional capacity, but also improved mental stature. Whilst the course at Birmingham has been an outstanding success, its support has been entirely from the metallurgical industries other than the foundry, yet the Department is especially well-equipped both by way of personnel and plant to widen and intensify the knowledge required by our industry's scientific staff. The lack of foundry graduates so far is due, no doubt, to the existence of the National Foundry College, which has been such a success in its own field. The two courses are, however, quite different, in that, while one is an excellent intensive training in a prescribed field, the other ranges over the whole field of metallurgy, whilst allowing much specialization in foundry practice.

The case for the post-graduate scientist in the foundry was extremely well expounded by Dr. Ivanhoff in a lecture which he gave to a congress organized by the Ironfounders' National Convention last year. He asked for men trained to a very high standard in mathematics, to include Bessel functions and hydraulics, so that the flow of metal and strength of materials should be thoroughly understood. This is an interesting statement which, being epitomized, indicates that there is a demand, perhaps as yet only latent, for high-grade technologists—not necessarily metallurgists—to aid foundries in their fight for efficiency. The post-graduate course at Birmingham goes far—very far—in meeting the future requirements of our industry, and firms would in their own interests be wise to investigate its potentialities *vis-à-vis* their own long-term policies.

Appreciation of the Edward Williams Lecture

When the Edward Williams Lecture—"Engineering Research Methods and Casting Problems,"*—of the 1954 conference of the Institute of British Foundrymen was delivered, the PRESIDENT, MR. JOHN BELL, said it was a great pleasure to him to invite Professor Scott to give the Lecture. He had known Prof. Scott since he was a boy and had watched his progress with interest. He was one of those who had had the Scottish scientific training—working in summer, studying in the winter, and he had made a success of it.

After the lecture, MR. J. J. SHEEHAN, past-president, in proposing a vote of thanks, said it was an excellent lecture, for it pointed out the complexities of the work on which founders were engaged. Stresses and strains were created in their metals by passing from elevated to low temperatures, but there had been very little mention of the stresses and strains put upon founders themselves, such as were caused by complexities of design.

Challenge of Design

Members had heard something about design from the president to the effect that they should do something to bring the matter before engineers connected with their work, but at times he felt that if it was not for the acceptance of engineers' designs there would not be made to-day the many castings that 30 or 40 years ago would have been considered impossible. The matter should be taken relatively and just a few fundamentals should be put before engineers, letting them carry on with the complex designs, leaving the foundrymen to meet their requirements by reason of increasing technical knowledge of casting.

DR. C. J. DADSWELL (also a past-president), seconding the vote of thanks, said that as a mechanical engineer who had turned foundryman some years ago he had been particularly interested to hear Professor Scott's suggestions for the treatment of foundry problems in an analytical way. Although it might be rather difficult to make models in glass, or even to mould in photo-elastic materials, one way which helped with large castings was to make models in wood on the scale of one inch to the foot. Such models could be handled and with them it was possible to imagine, to some extent, what went on in the way of directional solidification when the job was cast. Looking at a drawing of a casting 30 or 40 ft. long, it was almost impossible to visualize it properly, and a very practical way of giving substance to the job was the making of models and allowing foundrymen to consider them.

PROFESSOR SCOTT acknowledged the vote of thanks, thanking Dr. Dadswell and Mr. Sheehan, and said he thought it was good for one to hear different ways of doing things, even though such methods might not be immediately applicable to individual problems.

* Printed in the JOURNAL, June 24, 1954.

Conference Paper Authors

MR. E. O. LISSELL, joint author of the Paper "Correlation of the Properties of Castings and Test-bars in Grey Cast Iron," which is printed in this issue, graduated in metallurgical engineering at the Royal Institute of Technology, Stockholm, in 1937. He then went to the U.S.A. and obtained the degree of Master of Science in engineering at the University of Michigan in 1941. He was instructor and head of the foundry laboratory at the University for one year.

Returning to Sweden, Mr. Lissell became head of the foundry division and director of research of the Federation of Mechanical Engineering Industries, and retained this post until 1950. He then became foundry manager for Bjorneborgs Jernverks A.B., Bjorneborg, which post he still holds. He is a member of the Institute of British Foundrymen.

MR. M. ITZEL, joint author of the Paper, graduated in metallurgical engineering at the Royal Institute of Technology, Stockholm, in 1948. He then joined the research staff of the Boliden Mining Corporation, which post he relinquished in 1950 to take up an appointment as research engineer at the foundry laboratory of the Swedish Federation of Mechanical Engineering Institutes. He was promoted to head of the foundry laboratory in 1953.

Film Review

Britain's Heaviest Steel Casting

This 16-mm. film, which was shown at the Glasgow Conference of the Institute of British Foundrymen covers the making of a 185-ton steel casting at the Grimesthorpe works of English Steel Corporation. The casting was despatched to the United States where it is to form the frame of a large press. The photography, which is in colour, was carried out by the firm's staff, as indeed was the whole of the production. Lionel Marston was the commentator and accomplished his task very ably. The film shows how the pattern was divided into three parts, with the centre portion being of wedge formation to aid withdrawal.

The stripping of the casting from the mould and its subsequent journey to the coast was well covered. The showing lasts less than 20 minutes, which is on the short side for such a monumental enterprise. The film is noticeably free from advertising, and enters in the category of a documentary; this is as it should be, for buyers of large steel castings are never influenced by excessive "puffing". It is essentially a film for foundrymen and engineers, and as such ranks exceedingly high.

V. C. F.

Correlation of the Properties of Castings and Test-bars in Grey Cast Iron*

By Erik O. Lissell, M.Sc. and Morris Itzel, Met.Eng.

Official Exchange Paper from the *Sveriges Mekanfnrbund*

Fundamentally, the tentative Swedish specifications for cast-iron are drawn up for determination and control of the quality of the iron and thus to provide a tool for production control and to a lesser degree for inspection control. One single test-bar is specified to be cast under closely-controlled conditions and machined to a standard tensile-test specimen of set dimensions[1]. The ultimate goal is to make cast-iron testing as uniform as possible, irrespective of the particular foundry and thus the different grades of cast-iron identical throughout the country. It is, however, not only important that the various foundries shall produce irons of controlled quality to fulfill certain specifications, but equally important that the designer should know which one of a number of grades of specified irons to use for his castings. The Swedish Grey-Iron Standards Committee has therefore worked out a data sheet giving the minimum strength to be expected in various sections of actual castings for each of the standardized grades. Since only one test-bar is used to designate the iron, the approach to the problem of correlating test-bar and casting properties has been somewhat different from that used in other countries.

Test-bar and Casting

The principal problem in all cast-iron testing is to find the correlation between test-bar and casting. It can quite safely be stated that due to the pronounced section sensitivity of cast-iron and unknown or unpredictable cooling-rates in the different sections of most castings absolute relationships will never be established. Approximations acceptable for simpler castings have, however, been worked out and are to-day widely used. The fundamental principle in most specifications has been to cast test-bars of such a design and dimensions that they would solidify with approximately the same structure as the controlling section or main cross-sectional thickness of the actual castings. Due to the variations in size and thickness of cast products, this calls for a number of test-bars (varying between three and five in different specifications). The relationship between the diameters of these test-bars and the corresponding range of cross-sectional thicknesses in the castings has been determined empirically. Such data from different specifications are shown in Table I and Fig. 1.

This method of testing castings is undoubtedly very suitable for inspection control purposes in those cases where the test-bar to casting relationships can really be relied on. If the production control of the metal is to be correlated with the inspection control, however, this system has certain drawbacks. The main difficulty is that several test-bars are involved. There are two ways of coping with this problem, either the cast-iron grade has to be confined to any one of the standard bars, as in the American specifications, or to one of the bars only as in most other specifications. In the latter case a correlation between the different sizes of bars has to be established.

From the designers' point of view, the American standard specifications are very simple. Here one just decides which grade to specify and the calculations are based on this figure. It is then up to the foundry to make the casting in an iron which will give the desired strength in a test-bar corresponding to the ruling section of the casting. From a foundry point of view the actual number of iron classes may therefore theoretically be the standardized number of classes multiplied by three (the number of test-bars).

TABLE I.—*Correlation of Nominal Diameter of Test-bar as-cast and Main Cross-sectional Thickness of a Casting According to British, American and German Specifications.*

Specification.	Nominal diameter of test-bar as cast. (In.)	Main cross-sectional thickness of casting. (In.)
British	0.6	¼ and under
	0.875	¼ to ½
	1.2	½ to 1¼
	1.6	1¼ to 1¾
	2.1	1¾ and above
American	0.875	0.50 and under
	1.2	0.51 to 1.0
	2.0	1.01 to 2.0
German	0.512	0.157 to 0.315
	0.787	0.315 to 0.591
	1.18	0.591 to 1.18
	1.77	1.18 to 1.97

For the British designer, the problem is first to find the test-bar, which corresponds to the main cross-sectional thickness of his casting. Then he looks for the grade which according to the tables will give the desired strength in his bar. His choice of grade will be correct only if the corresponding nominal test-bar to casting relationship is correct on one hand and the corresponding nominal test-bar

* Presented at the fifty-first annual meeting of the Institute of British Foundrymen held in Glasgow. The Authors are attached, respectively, to Björneborgs Jernverks, AB, Sweden, and the foundry laboratory, Federation of Swedish Mechanical Engineering Industries.

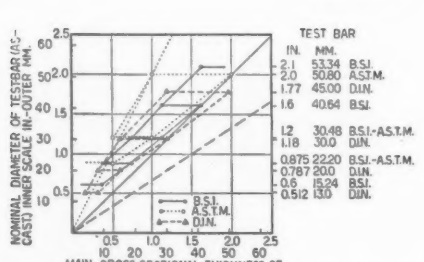


FIG. 1.—*Correlation of nominal diameter of test-bar as-cast and ruling cross-sectional thickness of the casting, according to British, American and German specifications. Superimposed are lines of correlation between test-bar and a large plate, a long, round bar and a sphere.*

to the 1.2 in. dia., "grade-designating" test-bar relationship on the other.

Correlation Between Cast Shapes

The structure obtained in a given casting, when poured in a specified grey iron is primarily governed by the cooling rates in different sections of the casting. If the cooling rate of any casting could be computed with fair accuracy, it might be possible to find a truer relationship between test-bar and casting than is possible to-day. It seems feasible that some of the results reported in the current research work on heat-transfer, solidification time and risering could be applied to such calculations. This statement is supported by at least a modicum of experimental evidence. Schwartz and Väth[3] showed that for the strength obtained in a long cylinder and a large plate cast in the same iron the following relationship could be established:

$$D = 2T$$

where D is the diameter of the round bar and T the thickness of the plate.

The heat extraction from a casting is generally considered to be proportional to the volume : surface-area ratio, other factors kept more or less constant. By comparing the volume : surface-area ratios for different shapes, among these the V/SA ratios for a long cylinder and a large plate, a good agreement is obtained with the relationship determined experimentally by the investigators mentioned earlier. Table II shows a number of V/SA ratios for simple shapes.

TABLE II.—*Geometric V/SA Relationships for Various Simple Shapes.*[3]

Shape.	Volume.	Surface area of heat extraction.	V/SA ratio.
Sphere .. .. D_s = diameter	$\frac{\pi D_s^3}{6}$	πD_s^2	$D_s/6$
Long cylinder— D_c = diameter L = length	$\frac{\pi D_c^2 L}{4}$	$\pi D_c L$	$D_c/4$
Long, square bar— T_b = thickness L = length	$T_b^2 L$	$4 T_b L$	$T_b/4$
Large plate— T_p = thickness L = length and width	$L^2 . T_p$	$2 L^2$	$T_p/2$

Assuming that equal V/SA ratios give the same tensile strength when other factors are constant one obtains:

$$V/SA = D_c/4 = T_p/2 \text{ or } D_c = 2T_p.$$

This is the same relationship emperically found by Schwartz and Väth.

Similarly, the following relationship may be computed for a long cylinder and a sphere:

$$D_c = 2/3.D_s.$$

If the test-bar in Fig. 1 is looked upon as a long cylinder and the diameter of a sphere, the diameter of another round bar and the thickness of a plate are supposed to represent the main cross-sectional thickness of these simple shapes, the relationships between the test-bar and these castings may be calculated by means of the formulæ given. These relationships are displayed as straight lines in Fig. 1. The graph shows that the relationships between nominal test-bar diameter and main cross-sectional thickness as expressed by the American, British and German specifications fall largely between the lines depicting the relationships between test-bar and long, cylindrical bar and test-bar and large plate respectively. It can therefore safely be stated that the relationships between test-bar and casting properties can be calculated from the V/SA ratios with just as satisfactory an accuracy as they are given in most specifications, if not better. If the ruling section in a casting approaches the shape of a semi-infinite plate about the same strength can be expected as that obtained in a test-bar of a diameter twice the thickness of the plate. The more rounded and compact the casting becomes, the more similar will be the test-bar and casting strength values when the section size of the casting and the test-bar approach each other.

If, therefore, the minimum tensile strength values to be expected in a round bar of any diameter for any one of a number of specified grey-irons is known, it will be fairly easy for a designer to select an iron grade to suit his needs. It will be still easier if tables be worked out giving the minimum strength values which will most probably be obtained in long, round bars and large plates of various diameters and thicknesses. The problem that remains is to find the correlation between tensile strength and bar diameter.

Statistical Approach

The classical method to determine section sensitivity in an iron is to cast a number of melts into test-bars of different diameters, machine tensile test specimens from these bars and test them. The strength data thus obtained are then plotted in a diagram as a function of bar diameter. The average strength, as well as the deviation from the mean, is computed for each diameter. A smooth curve connecting the different minimum strength values indicates the section sensitivity. The procedure outlined above may differ, but the section sensitivity is always given as a smooth line in the diagram.

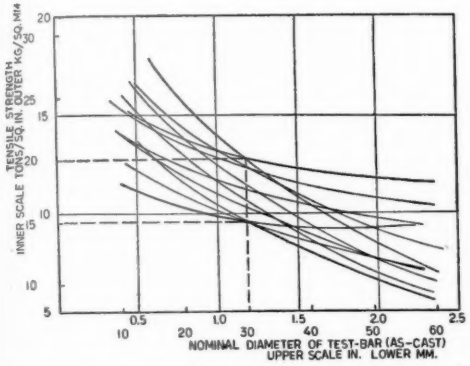


FIG. 2.—*Section-sensitivity curves for irons complying with the Swedish grade* 0115, *i.e., between the* 15-*kg. per sq. mm.* (9.53 *tons per sq. in.*) *and the* 20-*kg. per sq. mm.* (12.70 *tons per sq. in.*) *limits for the* 30 *mm.* (1.18 *in.*) *test-bar.*

This concept of section sensitivity can not be applied when the relationship between the strength in a ruling test-bar and any other test-bar size shall be established. Fig. 2 indicates the reason. The diagram shows a number of "idealized" strength *v.* test-bar diameter curves for irons complying with the Swedish grade 15, *i.e.*, irons with a minimum tensile strength of 15 kg. per sq. mm. (9.53 tons per sq. in.) in the 30 mm. dia. bar (1.18 in.). A maximum tensile strength is not specified but to make the diagram clearer 20 kg. per sq. mm. has been chosen as the upper limit (12.70 tons per sq. in.). Due to variations in the section sensitivity, some of the curves that pass through the lower limiting point will have a steeper, and others a flatter course. The same is obviously true also for the upper point. Statistically, the correlation between the minimum tensile strength obtained in the 30-mm. test-bar and the minimum strength in any other diameter bar will be given by two curves passing through the 15 kg. per sq. mm. point of which one is the steepest and the other the flattest. The correlation curve is therefore not a smooth line but a curve with a pronounced hump at the diameter corresponding to the ruling test-bar. The same general type of curve will be obtained whatever size of test-bar be chosen as the ruling one. This makes a two-way correlation between two or more test-bars virtually impossible. The reason for this is as follows:—Take any grey-iron specification in which the minimum tensile strength in each one of several standardized test-bars is given for every standard grade of iron, and assume that there exist tensile data from a large number of heats of similar irons cast in all of the standard bars. The section-sensitivity curves for each of these irons are then plotted. From all these curves are selected those which when plotted as a tensile strength : test-bar diameter diagram will pass through the points corresponding to the minimum tensile strength specified for two different size test-bars cast in the same iron. The result is schematically shown in Fig. 3. Two humped curves similar to the one in Fig. 2 are obtained which *do not coincide.*

The following conclusions can be drawn from the reasoning above and Figs. 2 and 3. If cast-iron specifications be based on one ruling test-bar size A, and the correlation between this test-bar and any other size test-bar is established as in Fig. 2, it is possible to forecast the minimum strength in any other size bar with complete certainty. If on another occasion the same strength is obtained in bar B, it is not at all certain that test-bar A, cast in the same iron will comply with the specification.

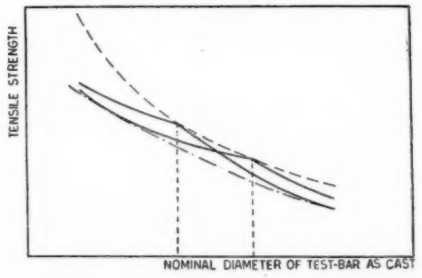
There are only two solutions to the problem. The first, and seemingly the simplest one, is to omit the correlation between the bars of different size, as in the American specifications, the second is always to cast the grade-ruling test-bar and use any other size of test-bar for control purposes only or at the customer's request.

Relationship between Bars of Varying Size

To determine the correlation between round bars of different diameters, a number of test-bars were cast at four Swedish foundries. From each of about 200 melts test-bars of 15-, 30-, 45- and 60-mm. dia. (0.59, 1.18, 1.77 and 2.36 in.) were cast, and machined to tensile-test specimens of 10-, 20-, 30- and 40-mm. (0.39, 0.79, 1.18 and 1.58 in.) gauge diameter. The 30-mm. (1.18 in.) bar was cast according to Swedish standard specifications[3, 4]. From publications by Angus, Dunn and Marles[5], Jungbluth[6], Shuck[7] and Jungbluth and Heller[8] corresponding tensile strength and test-bar diameter data have been drawn from another 125 melts.

Tensile strength *v.* test-bar diameter was plotted for all irons with a tensile strength between 15 and 20 kg. per sq. mm. (9.53 to 12.70 tons per sq. in.), 20 and 25 kg. per sq. mm. (12.70 to 15.88 tons per sq. in.) etc., in the 30-mm. dia. bar. In this way, the graphs shown in Fig. 4 were obtained for the lowest, 15-kg. per sq. mm., grade. The diagrams for the other grades were similar. Some figures taken from the literature for other irons, which were not cast in a 30-mm. or 1.2 in. bar were graded by interpolation, *i.e.*, if the interpolated strength fell within the 15 to 20 kg. per sq. mm. interval, the iron was considered belonging to that grade, etc.

FIG. 3.—*Curves showing the correlation between two different test-bars, each functioning as a separate ruling test-bar, and other test-bars.*



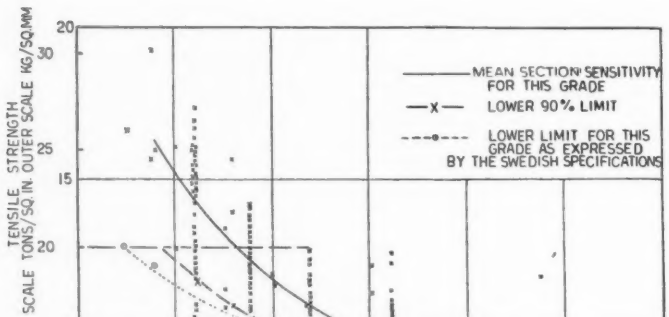

TENSILE STRENGTH
INNER SCALE TONS/SQ.IN. OUTER SCALE KG/SQ.MM
MEAN SECTION SENSITIVITY FOR THIS GRADE
LOWER 90% LIMIT
LOWER LIMIT FOR THIS GRADE AS EXPRESSED BY THE SWEDISH SPECIFICATIONS
NOMINAL DIAMETER OF TEST-BAR (AS-CAST)
UPPER SCALE IN. LOWER MM

FIG. 4.—*Relationship between the ruling 30-mm. (1.18 in.) test-bar and other round bars. The full line shows the average section sensitivity for all values and the dotted line gives the lower 90 per cent. confidence limit. Circles represent the recommended standard values.*

All the irons covered by Fig. 4 have one thing in common; their section sensitivity curves cut the vertical through the 30-mm. point on the abscissa between 15 and 20 kg. per sq. mm. Theoretically, an unlimited number of curves will cut this interval at varying inclinations. The lower limit of all these curves is represented by two different curves meeting in the 15-kg. per sq. mm.—30 mm. diameter point. The humped curve mentioned before is obtained. By using normal methods of calculation, the average section-sensitivity curve was determined and plotted, as shown by the full line in Fig. 4. The reason why it does not pass through the middle of the ruling interval is undoubtedly that the number of values is insufficiently large. The slope and shape of the two branches of the curve representing the minimum tensile strength were determined by computing the 90 per cent. confidence limits of the deviation from the mean; the hatched line in Fig. 4. The circles combined by the dotted line give the values recommended by the Standards Committee for design purposes.

The other grades of grey-iron, except grade 35, have been treated in a similar manner. In Fig. 5 is shown the section sensitivity curves as expressed in the British and German standard specifications together with the Swedish correlation curves. It should be stressed that the dots and crosses on the British and German curves represent specified minimum tensile strength values in standardized bars while this is only the case for the 30-mm. (1.18 in.) bar in the Swedish curve. The difference between the curves is quite obvious. It is of interest to note that the slope of the upper branch of the Swedish curves approximately follows that of the British curves and the lower branch that of the German ones.

Swedish Specifications for Grey Iron

A summary of the Swedish Specifications for grey-iron is shown in Table III. Hitherto four grades with minimum tensile strengths of 15-, 20-, 25-, and 30-kg. per sq. mm. in the 30-mm. diameter test-bar have been standardized. The 35-kg. per sq. mm.-grade is as yet only tentative. To prevent too high a hardness in the standardized irons, maximum hardness values are also specified for each grade.

Recommendations for Designers

On the basis of the correlations worked out between the 30-mm. (1.18-in.) standard test-bar and

TABLE III.—*Grades of Grey Cast Iron According to the Swedish Specifications; Test-bar Size* 1.18 *in.*

Grade.	Minimum tensile strength.		Maximum Brinell hardness number (5-mm. ball, 750-kg. load).
	Tons per sq. in.	Kg. per sq. mm.	
0115	9.53	15	190
0120	12.70	20	210
0125	15.88	25	230
0130	19.05	30	250
0135*	22.23	35	270

* tentative

FIG. 5.—*Relationship between tensile strength and nominal diameter of test-bars according to British and German standard specifications and the relationship between ruling test-bar and other round bars according to Swedish design recommendations*

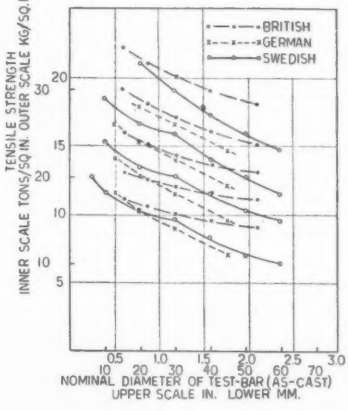


TABLE IV.—*Data Sheet for Standard Iron Grades.*

For design purposes, the following approximate values may be used for cylindrical castings of great length in proportion to diameter and for plate-shaped castings of great length and width in proportion to thickness.

Casting.				Cast-iron grade.											
Cylinder, diameter.		Plate, thickness.		0115.			0120.			0125.			0130.		
				Minimum tensile strength.		Brinell hardness number, ±30	Minimum tensile strength.		Brinell hardness number, ±30	Minimum tensil e strength.		Brinell hardness number, ±30	Minimum tensile strength.		Brinell hardness number ±30
mm.	in.	mm.	in.	kg. per sq. mm.	tons per sq. in.		kg. per sq. mm.	tons per sq. in.		kg. per sq. mm.	tons per sq. in.		kg. per sq. mm.	tons per sq. in.	
6	0.24	3	0.12	20	12.7	220	—	—	—	—	—	—	—	—	—
10	0.39	5	0.20	18	11.4	200	24	15.2	230	29	18.4	250	—	—	—
20	0.79	10	0.39	16	10.2	180	21	13.3	210	26	16.5	230	33	21.0	250
30	1.18	15	0.59	15	9.5	170	20	12.7	190	25	15.9	210	30	19.0	230
40	1.58	20	0.79	13	8.3	160	18	11.4	180	22	14.0	200	27	17.1	220
50	1.97	25	0.98	11	7.0	150	16	10.2	180	20	12.7	200	25	15.9	210
60	2.36	30	1.18	10	6.3	140	15	9.5	170	18	11.4	190	23	14.6	210

other round test-bars, as well as the relationship between the tensile strength in a long cylindrical bar and a large plate, the recommendations for designers shown in Table IV have been worked out. In this Table the normal range of hardness values to be expected in the two simple shapes just mentioned is also indicated. These data are based on hardness measurements on the Swedish irons tested by the Committee and the data given by MacKenzie[9] who correlated tensile strength and hardness in about 1,500 different test-bars.

This Table can be used to estimate the tensile strength to be expected not only in simple shapes but also in actual castings, as has been shown previously, when the grade of the iron is known. It can also be used by the designer to decide which grade to specify to obtain a certain tensile strength in the ruling section of a casting. The determination is definitely only approximate and should be used with discretion in the case of complicated castings.

Summary

Different ways of correlating test-bar properties and casting properties are discussed. Even if the relationships used at the moment are rather approximate, they can be used as a rough guide both by the designer and the inspector. It has been shown how the relationship between one ruling test-bar and other round bars can be established statistically. No two-way relationship can, however, be evaluated between two or more test-bars.

It is suggested that the work on heat-transfer and cooling rates be extended into the field of cast-iron testing as a possible means of calculating relationships between different shapes and of predicting strength in different kinds of castings.

The Swedish standard for grey iron is detailed, as well as the recommendations evolved for designers to enable them to specify a suitable grade for their designs.

REFERENCES.

[1] Lissell, E. O., Testing the Metal or Testing the Casting, FOUNDRY TRADE JOURNAL, 1950, **89**, 357-364, 391-397.
[2] v. Schwarz, M., and Väth, A., *Beziehungen zwischen der Wandstärke, dem Stabdurchmesser und dem Maurer-Diagramm für Gusseisen, Giesserei*. 1933, **21**, 373-376.
[3] Pellini, W. S., Factors which Determine Riser Adequacy and Feeding Range, *Trans.* Amer. Foundrymen's Soc., 1953, **61**, 61-80.
[4] SIS 11 21 29, *Dragprovstav typ T, Provstav för grått gjutjärn med obetydlig förlängning, Sveriges Standardiseringskommission*, 1950.
[5] Angus, H. T., Dunn, F., and Marles, D., Properties of Cast Iron in Relation to the Carbon-equivalent Value, *Trans.* Amer. Foundrymen's Soc., 1949, **57**, 24-44.
[6] Jungbluth, H., *Aenderung von Zugfestigkeit und Brinellhärte bei Gusseisen mit der Wandstärke, Arch. Eisenhüttenwesen*, 1936, **10**, 211-216.
[7] Shuck, A. B., Laboratory Evaluation of Some Automotive Cast Irons. *Trans.* Amer. Foundrymen's Soc., 1948, **56**, 166-193.
[8] Heller, P. A., and Jungbluth, H., *Die Wandstärkenempfindlichkeit getrennt gegossener Gusseisenproben und ihre Beziehung zur Chemischen Zusammensetzung. Arch. Eisenhüttenwesen*, 1934-35, **8**, 75-82.
[9] MacKenzie, J. T., Brinell Hardness of Gray Cast Iron and Its Relation to some Other Properties, *Proc.* Amer. Soc. Test. Mat., 1946, **46**, 1025-1038.

Board Changes

BRITISH ALUMINIUM COMPANY, LIMITED—Mr. G. A. Steel has retired from the board.

WICKMAN, LIMITED—Mr. G. R. Marsh, a director, has been appointed managing director.

BIRFIELD INDUSTRIES, LIMITED—Col. J. R. Pinsent has been appointed an additional director.

TANGYES, LIMITED—Mr. D. J. Ault, secretary, has been appointed to the board of the company.

NON-FERROUS METAL PRODUCTS, LIMITED—Mr. Christopher W. Garnett has joined the board.

RUSTON & HORNSBY, LIMITED—Mr. W. Haynes and Mr. E. W. Spalding have retired from the board.

LITHGOWS, LIMITED—Mr. Alexander H. White, managing director, has been appointed deputy chairman of the company.

ELECTRIC CONSTRUCTION COMPANY, LIMITED. Mr. J. C. Milne has been appointed to the board as technical director. He joined the company in 1934.

MONSANTO CHEMICALS (AUSTRALIA), LIMITED—Mr. Edward A. O'Neal, Jnr., has resigned from the board and Mr. P. A. Singleton, managing director of Monsanto Chemicals, Limited, has been elected in his place. Mr. O'Neal will continue to take a close interest in the affairs of the parent British company, Monsanto Chemicals, Limited.

ENGLISH STEEL CORPORATION, LIMITED—Following reacquisition of the equity by Vickers and Cammell Laird & Company, Limited, Lieut.-Gen. Sir Ronald Weeks (chairman of Vickers) and Mr. R. W. Johnson (managing director of Cammell Laird) have rejoined the board. Additional appointments to the board are: Mr. J. C. Mather (chairman of Cammell Laird & Company, Limited), Col. A. T. Maxwell (director of Vickers, Limited), and Mr. E. J. Waddington (director of Vickers-Armstrongs, Limited). Other directors who retain seats on the board are: Mr. F. Pickworth (managing director), Dr. H. H. Burton, Dr. C. J. Dadswell, Mr. B. Gray, Mr. W. D. Pugh, and Mr. R. G. H. Taylor. Lieut.-Gen. Sir Ronald Weeks has resumed the chairmanship of the Corporation.

Graduate Course in Metallurgy

The purpose of the Graduate School of Metallurgy of the University, Birmingham, is to provide facilities for the study, at a high standard, of modern developments in metallurgy and of their application to metallurgical industry. The School is part of a national scheme designed to serve the major industries of the country by providing for the necessary training to be carried out at selected universities.

It is essential that Britain should strengthen her ability to make prompt application of advances in scientific knowledge to the processes of industrial production. Most graduates whose work in industry demands a broad understanding of the technical and economic aspects of metallurgical processes are conscious of the need to keep in touch with new developments in metallurgical theory and practice. Because information on recent developments is widely dispersed and sometimes obscure, they often find it difficult to maintain this contact while preoccupied with the day-to-day requirements of their particular jobs. Similarly, graduates who are working in specialized branches of metallurgy and perforce concentrating their interest and effort in a narrow field, cannot easily keep abreast of the rapid advances taking place in other subjects allied to their speciality. It is important that they should do this because advances in one field of knowledge can often provide the key to the problems of another.

Duration of Study and Conditions of Entry

Although nominally of one year's duration, the course is so arranged that the period of full-time attendance at the University is completed in the first nine months of the session, *i.e.*, from early October until the beginning of the following July. During the final three months each candidate must study and present a thesis on a suitable metallurgical subject. The normal qualification for entrance is a suitable degree in metallurgy physics, chemistry or engineering, or an equivalent professional qualification. In general it is expected that entrants will have spent some time, preferably two years or more, in metallurgical industry, but in suitable cases metallurgical graduates with less industrial experience may be admitted.

Degree and Diploma Awards

Subject to a satisfactory performance by the candidate during the session and at the final examinations, on completion of the 12-months' course students possessing a Bachelor's degree may qualify for the award of the degree of Master of Science. Students completing the course satisfactorily who have not taken a University degree are awarded the Diploma in Post-Graduate Studies (Metallurgy).

Lecture Courses

Five lecture courses are given during the session, each consisting of a number of separate topics. The first deals principally with factors affecting the structure and economics of metallurgical industry. The course is designed, therefore, to show how factors such as plant lay-out, technical process control methods, organization and management affect the economy of manufacture. The second and third deal with the theory and practice of metallurgical manufacturing processes. In these emphasis is laid upon the application of modern theoretical knowledge to the manufacturing operations of melting and casting, hot and cold working, and the joining of metals. For example, in the course on melting and casting, application of thermodynamics to reactions involving molten metals are discussed and, in the case of metal-working operations, recent advances in the theory of deformation processes and of lubrication are considered. The fourth is especially concerned with the properties of materials and with techniques of examination. In this course, modern methods for the non-destructive testing of metallic components are considered. Some emphasis is also placed on the applications of X-ray crystallography to metallurgical problems. Many metallurgical phenomena can be understood only in terms of crystallography and it is likely that X-ray diffraction techniques will play an increasingly important rôle both in metallurgical investigations and in routine control work. The last course takes the form of a review of physical theoretical metallurgy.

Practical Work and Other Activities

The lecture courses are illustrated and augmented by practical work in the Aitchison Laboratories. These are equipped with representative examples of full-scale manufacturing plant used in a wide range of casting and metal working operations. Modern equipment for mechanical and non-destructive testing, metallography and X-ray crystallography is also available. In their practical work students may study the application of the scientific principles discussed in lectures to investigations and development work under the conditions of practical production. Where possible, work of this type is supplemented with selected visits to metallurgical works using advanced techniques of manufacture.

Other activities include seminars, in which each student during the course of a session gives two or three papers on a subject broadly related to the field of industrial metallurgy. Each is followed by an informal discussion amongst the post-graduate and honours students present. A less-tangible but important aspect is that during their full-time course graduate students have the opportunity of taking a full share in university life. Provision has been made for some of the students to live in a hostel established by the University at Chad Hill, where students from the other Graduate Schools (Mechanical and Chemical Engineering and Engineering Production) and also research students from other departments will be in residence.

Forms of application may be obtained from the Registrar, The University, Edgbaston, Birmingham, 15, and further information about the course from the Department of Industrial Metallurgy.

Antique Clock

A very early turret-clock, made in iron by an Elizabethan blacksmith in the days before clockmakers were recognized as such (*circa* 1580), attracted much attention at the Antique Dealers' Fair at Grosvenor House, Park Lane, recently. It comes from Cassiobury Park, Watford, and is driven by two wheels and a folliot. The latter is a kind of governor with little adjustable weights at either end and it makes one revolution every 3½ secs. These were the years before the invention of the pendulum, which did not make its appearance until the middle of the 17th century. The clock has no visible dial and local citizens in the reign of Queen Elizabeth I could only learn the time of day by hearing it strike the hours. Its bell weighed 3 cwt. The clock has a small interior hour dial as an indicator for the information of the clockmaker and winder.

High-pressure Moulding in America

*By B. H. C. Waters, M.A., Ph.D.**

Introduction

Since shell moulding was introduced to the foundry, other processes have been developed which, while adhering more closely to conventional moulding practice, strive for the closer control of dimensional tolerances generally associated with the shell moulding. One of these is high-pressure moulding, using moulding presses of some 600 lb. per sq. in. instead of the conventional 40 lb. per sq. in. In these conditions, and by the appropriate control of sand composition, moulds can be produced within, it is claimed, tolerances of 0.001 in. per inch. This is better than most shell-moulding operations. At present, the process is still very largely in its experimental stages. Although it is said that grey-iron castings of up to 100 lb. weight have been made commercially by high-pressure moulding, no operations on any scale such as this were seen by the Author.

Equipment

The essential equipment used is a press capable of giving pressures of some 2,000 lb. per sq. in. For development stages, an appropriately adapted tensile-testing machine was used. Suitable moulding boxes capable of withstanding the high pressure are also needed. They are usually made of steel, a size on which considerable work has been done being a box 5 by 10 by 6 in. Inside this box, a squeeze plate moves with a clearance of some $\frac{1}{32}$ in. around its outside edges. To achieve the accuracy of which the process is capable the boxes must be made to exact dimensions, for easy travel of the squeeze plate, and they must be very accurately fitted with pins and bushings. The need for great strength and great accuracy in the boxes used would necessitate the maximum possible standardization in production equipment. The moulding-box surfaces should also be given a fine machine finish to prevent the compressed sand fouling the box side.

Patterns used must be made of steel, as they are subject to considerable wear. Because the process aims at high precision, the patterns have to be correspondingly accurate. The moulding machines employed must be of the cope-and-drag variety, and fitted with squeeze plates appropriate to the size of the individual boxes used.

Sands Used

The sand adopted in this process has to be of a highly flowable nature since at the end its density is high—said to be some 20 per cent. more than ordinary green-sand-moulding density. To obtain the surface finish of which this process is capable, and maintain flowability, the sand should also be fine, preferably of 90 to 95 A.F.S. with a four-screen distribution. Sands ranging from 65 to 130 A.F.S. have, however, been used.

The water content of the sand used must be low—under 1 per cent.—as the pressures used tend to squeeze water out on to the surface of the pattern. Addition agents are incorporated to coat the sand and provide the necessary strength; these are resins, which a subsequent addition of solvent makes sticky. The sand and resin are mixed for 3 to 5 min., using a conventional roller-type mill. By contrast with shell moulding, heating of the sand during mixing need not be avoided and may be desirable. The worked sand is first mixed with 1 to 1½ per cent. liquid resin to coat the sand grains, after which an addition of 0.5 to 1.5 per cent. dry resin is made—the purpose of this addition being to increase the resin viscosity. Finally about 2 per cent. southern bentonite is added and mixed.

Mould Production

Moulds are produced on patterns pre-coated with silicone oil in a way similar to that used in shell moulding. In much of the work done to date core-boxes have been used. Pressures used are about 600 lb. per sq. in. and curves published showing the strength characteristics of the sands used indicate that the strengths approach limiting values as the pressure is increased. Pressures up to 2,000 lb. per sq. in. have, however, been used. The pressure is applied for about 10 secs.

Mould Characteristics

The process gives a high mould-hardness and low permeability, hardness figures of 98 and permeability of 17 being quoted. The mould can be readily handled; it needs no slip jackets for pouring, and will support weights and resist the metallostatic pressure of molten metal upon it. It is claimed that the low permeability does not matter since there is little moisture present to produce gas. The nature of the resin and the temperature it will resist have not yet been disclosed, though a recent publication mentions, perhaps somewhat ominously, that for castings made by this method over-cleaning can quickly roughen the surfaces obtained.

It is reported that in pouring at temperatures of some 1,525 deg. C. the mould contracts slightly, and this avoidance of expansion apparently eliminates burn on, penetration, and scabbing. Castings made by this method have a very clean strip, the mould breaking away in chunks. Sand reclamation is very much simplified. Only cleaning and separation of tramp metal is necessary. The sand can be immediately re-used without mixing or aeration, and has been used up to nine times without further additions and with a 95 per cent. return.

Casting finish is said to be similar to that obtained with shell moulding, and it is claimed that tolerances of 0.001 in. per inch are held, though it is likely that these have been shown only in very small-scale experimental operations. Cleaning time is reduced compared with that for sand moulded castings. Running and gating systems are similar to

* The Author is now with William Jessop & Sons, Limited.

High-pressure Moulding

those used with shell moulding, so that the yield is increased compared with ordinary sand moulding.

Future Development

For the future it can only be said that this process appears to warrant attention in this country. Preliminary investigation, using a tensile-testing machine to apply pressure should not be very expensive and if spectacular tolerances claimed in experimental work can be held in routine production the method represents an important advance in foundry technique. As expensive pattern and corebox equipment is necessary, it seems that the process, even when developed, would be more suitable for the United States than the U.K., since so much standardization and such long runs would be necessary to justify the high cost of capital equipment. On the whole, the relatively conventional shell-moulding process appears to offer more promise for use in this country at the present stage.

Standardization of Pallets

Much trade and general interest has been manifested in the recent London meeting of the pallets committee of the International Organization for Standardization. The meeting—the technical committee's second—was held at the British Standards Institution's headquarters at 2, Park Street, W.1, from June 21 to 23, preceded by a meeting of the working group. There were 38 delegates present from nine countries and a number of observers.

At the meeting of the main committee, six resolutions concerning the dimensions and loading of standard pallets were agreed as follow:—

1. The maximum height from the ground to the underside of the top deck should be 5 in. and the minimum height for the passage of forks *from any side* should be 3¾ in.
2. Minimum openings in the bottom decks of 2-way and 4-way entry pallets of 32 by 40 in. and 40 by 48 in. shall be as indicated on drawings approved by the committee.
3. The width of wing of wing-type pallets should be 3½ in.
4. Maximum tolerances to be allowed on the length and width of standard pallets were specified.
5. The minimum rating for pallets of 32 by 40 in. and 40 by 48 in. should be 1,000 kg. and the minimum stacking load 4,000 kg. the question of test loads being referred back to for further consideration to the working group.
6. A third I.S.O. standard size of pallet of 32 by 40 in. was recommended for final approval.

The Group's next meeting is to be held in a few months time in Amsterdam by the kind invitation of the Netherlands Standards Association. This meeting will mainly be concerned with matters affecting the handling of pallets at ports, with particular reference to a proposed international stevedores' pallet. Requests were made that expendable pallets, chamfering of pallets, and the minimum percentage area of bottom decks of pallets should be added to the agenda. It was also agreed that in future discussions of pallets consideration should be given to their use by all forms of transport, whether by sea, river, road, rail or air.

New Catalogues

Shell-moulding Equipment.—A new leaflet from Fairbairn Lawson Combe Barbour, Limited, Leeds, 1, describes and clearly illustrates stages in the operation of their "Duplus" shell-moulding machine. It is claimed that 50-60 moulds per hour can be made by one man from a patternplate 24 by 16 in. A letter accompanying the leaflet states that overseas markets have been entered.

X-ray Dark-room Accessories

Kodak, Limited, Kodak House, Kingsway, London, W.C.2, have just issued a 12-page well-illustrated booklet, which details such useful accessories as tension hangers, channel hangers, hanger wall brackets, wet-film carriers, draining racks, lamps, and so forth. This should certainly be acquired by the research laboratories and those foundries operating X-ray departments. It is available on writing to Kodak House.

Core-sand Mixer.—A leaflet received from George Tweedy and Company, Limited, Chipping, near Preston, Lancs, describes and illustrates the Vortec make of sand mixer. It is available in two sizes, carrying either charges of 56 lb. or 1 cwt. It is claimed to be specially useful for shell-moulding practice. The mixer can be fitted with a perforated cutting plate and a perforated damper plate when reclaiming sand from used cores. The leaflet is available to readers on writing to Chipping.

Beryllium/Nickel. A leaflet received from the Beryllium Smelting Company, Limited, 36/38, Southampton Street, London, W.C.2, emanates from the Beryllium Corporation of Reading, Pa., U.S.A. It sets out the mechanical properties of beryllium/nickel castings—as-cast and heat-treated. It appears from the leaflet that two alloys are available in ingot form and some hints are printed as to handling in the foundry, though an offer of technical help is also indicated. The leaflet is available to readers on writing to Southampton Street.

Air-power Cylinders and Pneumatic Equipment. A catalogue of major interest to readers has been received from the United States Metallic Packing Company, Limited, Soho Works, Allerton Road, Bradford, 8, as it covers plant for lifting castings on to machines, push-off mechanisms to transfer moulds from conveyor lines to the knockout, and air hoists for many duties. The catalogue is essentially businesslike and carries numerous tables of dimensions and other data. From its nature it is a useful catalogue to preserve in the reference files. It is available to our readers on writing to Soho Works.

Oil burners. Rudling Liquid Fuel Burners, Limited, of 804-808, Green Lanes, Winchmore Hill, London, N.21, have produced a four-page leaflet describing and illustrating a simple type of burner, wherein the air and oil are swirled in opposite directions. The burner measures 5 in. by 1½ in. dia. and consumes about 80 cub. ft. of air per gallon of oil burnt. Varying with the type of oil used the consumption ranges from two pints to six gallons per hour. The oil pressure goes from 1 lb. per sq. in. to 15 lb. on maximum capacity, whilst that of the air starts at 2 lb. per sq. in. and rises to 10 lb. when on full load. This leaflet can be had on writing to Winchmore Hill.

Cupola Development*

First Report of Sub-committee T.S.43 of the Technical Council of the Institute of British Foundrymen

(*Continued from page 51*)

Constitution of Sub-committee T.S. 43

E. S. Renshaw, A.I.M. (chairman)
W. H. Bamford, F.I.M.
W. W. Braidwood
A. H. Cork
J. W. Dews
W. J. Driscoll, B.Sc.(Eng.), A.M.I.Mech.E.
F. Flubacher
J. W. Grant, A.M.I.Mech.E.
R. L. Handley, B.Sc.(Tech), A.M.I.E.E.
J. D. Hill, B.Sc.(Met.)
E. Morgan, M.Sc.
C. W. Moss
C. A. Payne, B.Sc.
R. P. Shaw
W. H. Smith
E. Walker
C. H. Wilson, M.I.I.A.
G. Lambert (secretary)

WATER-COOLED CUPOLAS (COLD BLAST)

Application of water-cooling methods to the melting zone of the cupola has been prompted for several reasons:—

(1) For economy in refractory materials and corresponding reduction in labour repair costs.

(2) To reduce the down-time for repairs, and to make possible prolonged operating periods.

(3) To retain constant diameter in the melting zone.

(4) To obtain a greater degree of control of slag composition by reducing the absorption of refractory material into the slag.

Acid Practice

The method of fitting parallel water jackets to form the inner lining of the cupola melting zone has been reported[8, 9] and after several years' experience of cupolas thus fitted, the method continues to give satisfaction to the users. In each case a saving in refractory of some 50 per cent. is obtained and although the heat lost to the cooling water is appreciable, there is no perceptible loss of metal temperature. The Sub-committee suggests that satisfactory operation with internal water jackets is dependent on the use of coke of recognized foundry quality. For example, an instance may be quoted in which on using a "furnace" grade of coke, a curtain or thin "skull" of metal remained on the surface of the jackets at the end of each operational shift, at times covering an appreciable area. It is recognized that small coke, in this case with 60 per cent passing through a 3 in. screen, offers considerable resistance to blast penetration and that under such conditions a greater proportion of the metal melts and descends in a zone nearer to the wall face. This is believed to be the reason for "skulling" at the jacket face with consequent loss of metal temperature.

Further work carried out with the internal-jacket type of cooler has been reported to this Sub-committee which reveals certain limitations to prolonged operating periods. When melting is continued beyond double-shift operation, pronounced erosion of the refractory wall in the area immediately above the top of the jackets has been noted (Figs. 1 and 2) resulting in exposure of the upper edge of the jackets with formation of "skulls."

This indicates that in the cooled zone adjacent to the jacket face, there is only limited combustion of the coke, the result being that oxygen is still available for combustion at the extremity of the jackets with the introduction of what might be termed a secondary melting zone.

Furthermore, with continued operation, erosion develops below the jackets (Figs. 1 and 2) particularly between the tuyeres, and is presumed to be due to slag attack. Any slag reaching this point will be rich in iron oxide because there is no opportunity for it to be diluted with refractory. Actually, samples of the slag frozen to the jacket face have been found to contain up to 60 per cent. of iron oxide.

These erosion effects, it was considered, might be overcome by introducing the air at a certain distance beyond the face of the jackets. The cupola was, therefore, fitted with water-cooled copper tuyeres protruding 9 in. beyond the jacket face (Fig. 3). Refractory attack at the points in question was effectively checked, the total refractory required for the repair being the negligible quantity of ½ lb. per ton of metal melted. However, the heat losses from the additional cooling system proved to be excessive resulting in low tapping temperatures, and the method was abandoned for this reason.

The investigation was subsequently pursued on the basis of the argument previously reported,[10] namely that when the refractory lining in the melting zone is set back some distance behind the

* Presented at the Institute of British Foundrymen's fifty-first annual meeting in Glasgow.

Cupola Development

tuyeres, there is an appreciable reduction in consumption of melting-zone refractory. Consequently, a cupola with a refractory-lined melting zone was fitted with projecting water-cooled copper tuyeres, and no other cooling arrangement used (Fig. 4). Firebricks of normal grade were used in the melting zone, and the well was rammed with a mixture of graphite and ganister.

Long Campaigns

Previous observations were confirmed when erosion proved to be slight both in the melting zone and below the tuyeres. It was found possible to operate this cupola for periods up to 100 hours without need to drop the coke bed and before it became necessary to renew the refractory lining of the melting zone. During a prolonged campaign, an indication of the erosion taking place could be obtained by temperature measurements made on the furnace shell by use of a surface contact pyrometer. The cupola bottom was dropped when the temperature of the shell in the melting zone region reached approximately 400 deg. C. When melting cylinder irons, the refractory consumption amounted to 6.4 lb. per ton of metal melted, representing a saving of 80 per cent. over conventional lining practice. Because water-cooling was restricted to the tuyeres there was a considerable reduction in water consumption. When operating with a volume of 1,500 galls. of water per hr., the temperature rise from inlet to outlet approximated 20 deg. C. and no loss of metal temperature was noted.

It might be expected that some danger could exist of metal streams impinging on the projecting tuyeres. However, when melting grey-iron charges with normal acid slags, tuyere life was found to be about twelve months, after which period they were replaced because of superficial surface cracks. It is suggested that this method gives the maximum saving of refractory with use of the minimum quantity of water and consequently less heat loss than previously reported designs for cold-blast, acid melting.

Basic Practice

Progress in basic-cupola melting has been retarded by the high cost of basic refractories and erosion in excess of that normally obtained with acid refractories. The considerable difference in performance of basic compared with acid refractories implies that where the acidic ash of the coke is in direct contact with basic material, preferential attack occurs before the ash can be fluxed with the descending limestone.

Improvement has been effected by pneumatic emplacement using the recently-introduced material, gun-cement/magnesite, a mixture of stabilized dolomite and magnesite with small amounts of bentonite. However, in order to make basic melting more economically attractive, some form of water-cooling appears to be necessary and attempts in this direction have been reported.[10] By the use of internal jackets and a basic refractory well, desulphurizing slags were formed for normal grey-iron melting. Subsequent investigations on the same subject have been placed at the disposal of the sub-committee and are reported herewith. The use of a water-jacketed melting zone gave satisfactory results when grey-iron charges containing limited quantities of steel scrap were melted. However, when the attempt was made to take advantage of the higher carbon absorption obtainable on melting with basic slags, and higher proportions of steel scrap were charged, the results proved less satisfactory due to the tendency for the scrap to fuse on to the jacket face causing excessive oxidation. Furthermore, slags of higher basicity were found to freeze at the base of the jackets with consequent interference with the melting conditions.

The success obtained with acid linings in the design according to Fig. 4 inspired further investigation of the application of protruding water-cooled copper tuyeres together with basic refractory in the melting zone and well. A 70 per cent. saving of refractory was obtained when chrome/magnesite bricks were used for the initial lining of the melting zone and well, and stabilized dolomite as the daily repair material. Replacement of the chrome/magnesite by stabilized-dolomite brick was less satisfactory as the saving in refractory only amounted to 30 per cent. of that obtained with normal basic practice and no water-cooling.

The basic-melting operation in the cupola under discussion was found to be normal when melting grey-iron charges with slag showing a lime/silica ratio in the range 1.2 to 1.4. With higher proportions of steel scrap and a more basic slag, "skull" formation became apparent on the tuyere surface and placed a limitation on the process. It is believed, however, that greater proportions of calcium fluoride would offset the freezing tendency in the tuyere zone by increasing the slag fluidity.

External Spray Cooling

The method of utilizing external spray cooling of the cupola shell has been investigated in conjunction with contour lining. This system is simple in that it consists of supplying water from a circumferential pipe fitted at a height of 8 to 10 ft. above the tuyeres and around the cupola shell. The shell should preferably be of welded construction to assist in obtaining a smooth curtain of water, and it is recommended that the steel surface be coated with aluminium by metalizing spray to limit corrosion. The water may be collected in a trough at the tuyere level or below it.

Fig. 5 shows the lining method which has been applied with this cooling system. The basic brickwork in the well is carried to a height of 6 in. above the tuyeres, above which gun cement magnesite is applied by pneumatic emplacement to a contour as indicated, giving a thickness of 3 in. of refractory in this zone. Basic refractory is continued to a height of 6 ft., the remainder of the stack lining being normal firebrick. During the melting operation, the refractory shelf above the tuyeres erodes in the usual manner and is replaced after each shift with gun cement magnesite. The upper portion of thin lining is found

to be reduced to a thickness of about 1 in., portions of the shell becoming exposed. The use of the pneumatic gun enables the thin portions of the magnesite to be easily replaced.

Although the method does not extend the operating period beyond a single shift, refractory consumption has been reduced by 26 per cent. The volume of water required amounts to 2,000 galls. per hr. for a shell diameter of 60 in. in the particular case quoted and metal temperatures are maintained as without water-cooling.

Summary

Summarizing, it is evident that a wide field of investigation is open on the subject of water cooling and further progress has been made. The use of protruding water-cooled tuyeres has the advantage of reducing the quantity of water required with lessened dissipation of heat. Application of water-cooling to the basic-lined cupola offers a possible solution to the lining problem and further work in this direction is strongly recommended.

The sub-committee plans to include in a further report more detailed descriptions of recommended systems of water cooling together with illustrations. Meanwhile, it is thought right to emphasize that various systems of water-cooling have been in successful use in cupolas in Britain and elsewhere for many years, and that their installation and use is not unduly difficult. Also that when these are properly installed, maintained and controlled they are safe and effective.

DESULPHURIZING AND CARBURIZING IN THE BASIC CUPOLA

Interest in basic-cupola melting revived two or three years ago as a result of pig-iron shortage when methods were sought of increasing carbon pick-up and with the advent of nodular iron for which low-sulphur base metal is desired. It has been established that melting under the influence of basic slag will result in carbon pick-up together with decrease of sulphur.[11,12,13,14,15]

For the purpose of discussion, this sub-committee

FIGS. 1 TO 6.—*Sectional diagrams of the cupolas considered.*

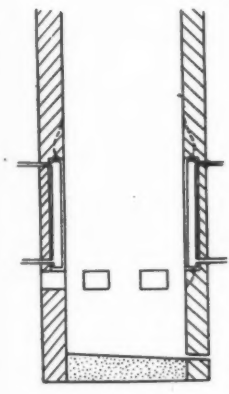


FIG. 1

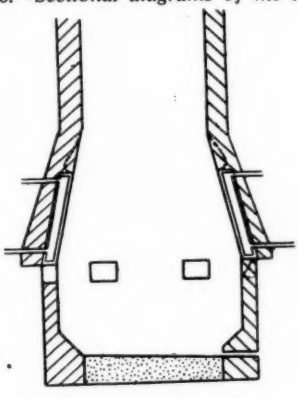


FIG. 2

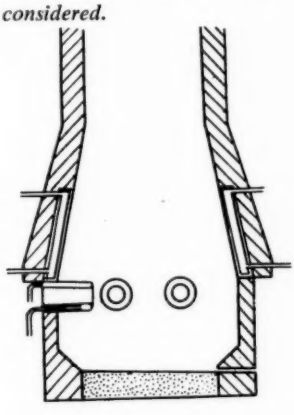


FIG. 3

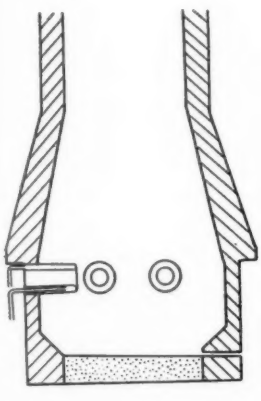


FIG. 4

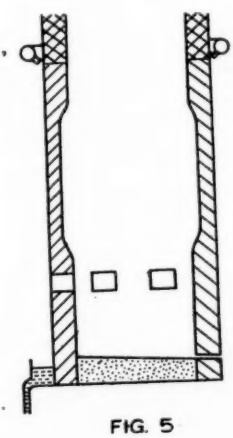


FIG. 5

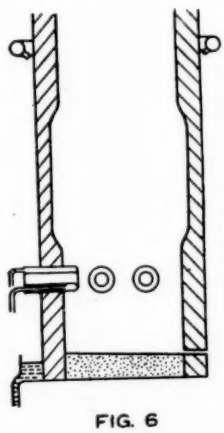


FIG. 6

TABLE VI.—*Carburization and Desulphurization in Basic Cupola Melts.*

Melt No. and type of charge.	Metal charge. Per cent.				Coke. Per cent.	Flux*		Charged composition, per cent.						Carbon (actual) per cent.					Silicon (actual) per cent.			Si. loss per cent.†	Sulphur, per cent.		P per cent.	Mn per cent.
	Pig-iron.	Iron scrap	Steel scrap	Alloys		Lime-stone.	Fluor-spar.	T.C.	Si	S	P	Mn	Aver-age.	Max.	Min.	Pick-up.	Acid pick-up.	Aver-age.	Max.	Min.		Aver-age.	Acid.		
1. All pig-iron	100	—	—	—	14	9.0	1.7	3.75	3.50	0.040	0.040	1.00	3.50	—	—	−0.25	−0.25	2.75	—	—	21.0	0.023	0.070	0.040	0.90
2. Ditto	100	—	—	—	18.7	4.16	2.08	3.58	2.68	0.045	0.270	1.04	3.59	3.68	3.39	0.01	—	2.26	2.37	2.11	15.7	0.025	—	0.280	0.89
3. All iron scrap	—	99.34	—	Ferro-silicon 0.66	12.0	10.0	0.85*	3.35	2.79	0.120	0.130	0.70	3.56	3.63	3.50	0.21	0.20	2.08	2.30	1.82	26.0	0.046	0.140	0.125	0.62
4. Grey iron	57.6	16.00	26.4	—	12.5	4.0	0.80	2.74	1.95	0.060	0.120	1.47	3.38	3.54	3.30	0.64	0.46	1.55	1.70	1.30	20.0	0.065	0.140	0.140	1.30
5. Low-carbon iron	—	99.40	—	Ferro-silicon 0.66	12.0	7.5	0.80	1.40	2.40	0.050	0.050	0.50	2.75	2.90	2.60	1.35	1.10	1.90	—	—	20.0	0.060	0.120	0.050	0.40
6. All iron & steel scrap	—	25.0	72.55	2.45	18.0	12.0	1.00	1.02	3.00	0.070	0.075	0.70	3.61	3.82	3.50	2.59	1.88	2.17	—	—	27.0	0.030	0.150	0.075	0.56
7. All steel scrap	—	—	96.20	3.80	18.0	12.0	2.00	0.25	3.00	0.050	0.050	0.66	3.35	3.50	2.90	3.10	2.50	2.35	—	—	22.0	0.033	0.160	0.040	0.56
8. All steel scrap	—	—	92.30	Briquettes 4.55Si-3.2Mn	22.0	10.0	2.50	0.60	2.18	—	—	2.15	3.68	3.93	3.54	3.08	2.40	0.91	1.09	0.68	58.0	0.017	0.200	0.025	1.21

* Expressed as per cent. of metal charge. † Silicon loss expressed as a percentage of the original silicon content.

has collected data produced by various workers in this field and Table VI reports the results obtained in a comprehensive range of cupola mixtures from all steel and iron scrap to all pig-iron.

Melts (1) and (2) are quoted for the purpose of showing that when the charged material is hypereutectic in composition, there is little change in the carbon content of the melted metal, but that sulphur can be reduced with a comparatively low-volume ratio of slag to metal and a slag of medium basicity.

Melt (3) shows an all-cast-iron scrap charge desulphurized to a low level with some degree of carburization. In this particular melt, the coke proportion was normal but the sulphur content of the metal could be lowered by melting with a greater ratio of slag to metal. Scrap-iron charges can thus be melted and remelted in the basic cupola with the sulphur content under control as distinct from acid melting in which the sulphur absorption is progressive and limits remelting.

Melt (4) represents a typical grey-iron melt in which the carburizing ability of basic melting made it possible to increase by 10 per cent. the steel-scrap content of the charge, in replacement of pig-iron, while holding carbon in the desired range at 3.38 per cent. Although the coke used in this melt was a high-sulphur blast-furnace grade, the sulphur content of the tapped iron was well below that obtained in acid melting with normal flux charges.

Melt (5) represents a low-carbon scrap melt in which sulphur is required to be below 0.070 per cent. with carbon pick-up normal. The flux charge is so proportioned as to give a slag basicity which will keep the sulphur content of the iron to the desired level while carbon pick-up is restricted by limitation of the coke quantity.

The three remaining examples in Table VI refer to attempts made to obtain a high degree of both carburization and desulphurization by use of high proportions of coke to create the necessary reducing conditions and to provide carbon for the carburizing reaction, together with extra amounts of flux to increase the basicity of the slag.

Melt (6) represents a mixture of cast-iron scrap and steel scrap in which the carbon was raised to the content normally present in pig-irons, and the sulphur held to an average of 0.030 per cent. Such a composition is suitable for nodulizing treatment and represents an economical base mixture.

Melt (7) represents an all-steel-scrap melt with ferro-silicon added for silicon adjustment and coke and flux charges similar to melt (6). The carbon is brought to the content normal for grey iron and the sulphur held to an average of 0.030 per cent.

Melt (8) illustrates a charge similar to that in Melt (7) with a higher coke proportion giving carbon pick-up to pig-iron levels and creating reducing conditions which promote a desulphurization to the low level of 0.017 per cent.

This series clearly demonstrates the considerable increase in carbon pick-up which can be obtained with basic slag operation and that the carburizing effect under such operating conditions is complementary to desulphurization. The charges chosen for the various melts were based on theories expressed by workers in this field, namely that reducing conditions should exist for effective desulphurization and high coke quantities furnish this requirement, while providing the carbon for absorption. The additional flux ensures a high CaO/SiO_2 ratio in the slag to aid absorption and retention of sulphur and also provides a higher ratio of slag volume to metal volume than in conventional practice. It would appear that the increase in slag proportion not only serves to lower the iron oxide content of the slag by dilution, but allows greater opportunity for slag/metal contact during the descent to the cupola well. It has been noted that as the proportion of flux is increased, a point is reached when the CaO/SiO_2 ratio exceeds 1.70 and the slag on cooling to room temperature "falls" to a powder. This suggests that di-calcium silicate has become a predominant constituent which on cooling exhibits the characteristic expansion feature resulting in "falling" slag.

Such a condition was reached in the case of melts (6), (7) and (8) and reference to Table VII which gives corresponding slag analyses, shows the basicity range capable of desulphurizing steel scrap charges to low levels.

Operational Problems

As distinct from normal acid-cupola practice, melting under the influence of basic slags must be considered a process in which specific reactions are purposely promoted. These reactions are unlikely to attain equilibrium in the furnace as presently constructed, and wider variations in composition can be expected. In well-conducted acid practice, the carbon and silican contents should normally be held within a range of ± 0.10 per cent. although with high steel melts, greater deviations are experienced. In basic melting, the range is extended to ± 0.20 per cent. for normal charges and is somewhat greater for steel-scrap charges with silicon concentrated in a limited proportion of the charge, *e.g.*, as ferro-silicon. The higher silicon loss, up to 25 per cent., must be considered when calculating charges and determining economies. It would appear that the use of a heated receiving unit is a desirable part of the process to accommodate the above-mentioned fluctuations, and it is recommended that the capacity of such a receiver should not be less than half the hourly melting rate of the cupola.

Continuous tapping methods are recommended in order to maintain a constant slag volume in the cupola well, which compels additional consideration to be given to slag fluidity. Furthermore, slags in the higher basicity range tend to skull around the tuyeres by contact with the incoming cold air. Calcium fluoride has proved to be effective in promoting the required fluidity and increased proportions are desirable for high limestone charges, some fluoride being retained in the final slag.

Summarizing this section, basic-slag operation offers the most effective means yet available for carburization and desulphurization of cupola charges. When the charge materials approximate to the eutectic or are of hyper-eutectic composition, desulphurization can proceed to any desired level dependent on slag basicity and coke ratio, and carbon pick-up is not appreciable. Scrap-iron charges can be repeatedly melted without the progressive sulphur pick-up associated with melting under acid slags.

Low-carbon or high-steel melts will carburize to high levels of carbon when slag basicity is increased and sufficient coke is present to provide the carbon for absorption and to produce reducing conditions. Desulphurization and carburization take place concurrently and the extent of each reaction depends on the coke and flux proportions.

Greater-than-normal fluctuations in carbon and silicon contents can be anticipated, but these can be minimized by adopting the precautions indicated above. There will be a higher loss of silicon than in acid practice, particularly with steel-scrap charges. The lining problem is discussed under the heading of water-cooling.

TABLE VII.—*Percentage Slag Composition Corresponding to Melts quoted in Table VI.*

Melt No.	CaO	SiO_2	Al_2O_3	MgO	FeO	MnO	S	CaF_2	$\frac{CaO}{SiO_2}$
1	44.20	31.10	8.10	10.62	1.25	0.70	0.60	3.12	1.42
2	43.60	31.70	9.40	9.70	1.80	2.00	—	*	1.38
3	45.20	34.20	7.35	9.94	1.57	0.51	0.73	2.00	1.32
4	42.90	35.20	8.50	10.20	1.05	1.10	0.95	*	1.22
5	43.50	32.50	9.05	9.20	1.25	1.14	1.02	2.00	1.33
6	53.90	28.80	7.73	7.56	0.55	0.30	1.12	*	1.87
7	52.10	26.03	7.10	8.01	0.80	0.93	0.98	4.06	2.00
8	51.44	24.80	11.35	7.23	1.29	1.04	0.55	*	2.10

* CaF_2 not determined.

Cupola Development

HOT-BLAST WATER-COOLED CUPOLAS

It has been shown that when refractory erosion is reduced to negligible proportions by the use of a water-cooling system, some further degree of control of the slag basicity is made possible. It is to be expected that with such basic-slag operation, desulphurization and carburization will follow providing the remaining requirements are met, namely, that the melting is carried out under reducing conditions and that the desired slag/metal reactions in the well are facilitated.

Furthermore, as the extent of refractory erosion determines the length of time a cupola melt can proceed, water-cooling will prolong this period. The applications of pre-heated air to the water-cooled cupola has ben described by Levi[16] and Doat[17]. In each case water-cooling is extensively applied to the melting zone, tuyeres and well.

This sub-committee is able to report work carried out in this country on a hot-blast cupola employing a similar water-cooling system. Details of the cupola are given under Plant B, Table I, and the water-cooling method is shown diagrammatically in Fig. 6, indicating the water spraying of the shell and the water-cooled copper tuyeres which extent inwards from the shell to a distance of 9 in.

Refractory Technique

With such an arrangement refractory may be applied to thickness of say 9 in., but erosion has been found to proceed in the normal manner until the water-cooling becomes effective. At this stage in the case of acid refractory a thin layer of about an inch in thickness will be retained on the shell, but basic refractory tends to erode complely, leaving a bare shell which appears, however, to be of little concern except for a rather greater heat loss to the cooling water.

By the time erosion is checked at or near the shell the water-cooled tuyeres become almost completely exposed, protruding beyond the lining face. Under these conditions it is suggested, particularly with hot-blast operation, that combustion of the coke is completed in a zone near to the tuyere nose and that little or no free oxygen will reach the cooled zone adjacent to the shell. This water-cooling system, therefore, is less likely to promote interference with the normal combustion conditions. A rammed, carbon lining has been found to give very satisfactory service in that portion of the furnace below the tuyeres, being inert to attack by both acid and basic slags. The initial lining above the tuyeres is preferably of rammed monolithic construction, although the air-emplacement method for basic refractory—gun/cement-magnesite—has been found to be satisfactory. The total refractory consumption amounts to less than 5 lb. per ton of metal when melting the types of charges discussed below, and the operating period between repairs is thus considerably extended. The continuous-tapping arrangement, with which the cupola is fitted, is lined with a graphite-ganister mixture, the tapping hole repairs being effected as required.

Heat lost to the cooling water.—The quantity of water found suitable for a cupola of the dimensions stated and the temperature increase of the water are given in Table VIII, the melting rate in this instance being 4.5 tons per hour, with a coke percentage of 16.7

In this example the amount of heat lost to the cooling water, 351,600 B.Th.U.'s per ton of metal melted, would result in lowering the tapping temperature were it not for the additional heat input by virtue of the pre-heated air, which in this case amounted to 514,500 B.Th.U.'s per ton of metal melted. It is for this reason that in the example of plant B (Table II), no increase in tapping temperature is recorded when operating with hot blast. In the case of larger cupolas it should be noted that the heat lost to the water would be less, due to the proportionately higher melting rate for a given surface area cooled.

In particular, then, for the smaller-size cupolas, fuel saving is not a feature of this type of arrangement. The benefits must be sought in other directions—such as the metallurgical effect on the charged materials.

Desulphurization and Carbonization

Table IX reports the results obtained when melting various mixtures in the cupola described above with a thin basic lining applied to the shell and carbonaceous refractory in the well, and operating with a hot-blast temperature averaging 470 deg. C. It should be particularly noted that the coke used in all melts was of blast-furnace grade.

Mixture (1).—This represents a typical grey-iron melt, the results having been previously reported in Table III and under plant B. In the absence of refractory erosion, due to water cooling, the flux was so proportioned as to give a slag with a CaO/SiO_2 ratio of 0.94, which is higher than the ratio of about 0.70 as with normal acid-slag practice. In consequence, the sulphur content of the metal was held to desired limits with a higher proportion of scrap in the charge than is possible with acid practice and using the same grade of furnace coke which is prone to give high pick-up of sulphur. The silicon loss was higher than with acid-slag operation.

TABLE VIII.—*Amount of Water and Temperature Increase for a 4½ tons-per-hour Cupola.*

	Quantity of water, galls. per minute.	Inlet temperature, deg. F.	Outlet temperature, deg. F.	Temperature rise, deg. F.	Heat loss per ton of metal melted (B.Th.U.'s.)	Total heat loss per ton of metal melted (B.Th.U's.)	Sensible heat of blast per ton of metal melted (B.Th.U's.)
Spraying of shell	48	75	108	33	211,600	351,600	514,500
Tuyeres	50	80	101	21	140,000		

TABLE IX.—*Hot-blast Water-cooled Cupola Melts.*

Tapping Temp. (Av.)	Slag.	Actual.	Silicon (actual).	Carbon	Charged composition.

TABLE IX.—*Hot-blast Water-cooled Cupola Melts.*

Mixture.	Type of charge.	Metal charge. —				Coke.	*Flux. †		Charged composition.					Carbon (actual).		Silicon (actual).		Actual.			Slag.	Tapping Temp. (Av.) deg. C.
		Pig-iron.	Iron scrap.	Steel scrap.	Fe-Si.		Lime-stone.	Fluor-spar.	T.C.	Si.	S.	P.	Mn.	Av.	Pick-up.	Av.	Loss. per cent†	S.	P.	Mn.	CaO: SiO_2 Ratio	
1	Grey Iron	42.4	36.0	21.6	—	12.5	2.80	0.40	2.84	2.42	0.069	0.20	0.74	3.33	0.49	2.11	12.80	0.100	0.20	0.64	0.94	1,455
2	Grey Iron	26.92	44.0	28.8	0.28	16.7	3.2	0.20	2.56	2.32	0.075	0.12	0.78	3.39	0.53	2.08	10.40	0.100	0.13	0.68	0.95	1,480
3	Iron and Steel Scrap	—	87.44	12.0	0.56	15.4	3.20	0.40	2.95	2.28	0.110	0.11	0.68	3.33	0.38	2.04	10.30	0.106	0.105	0.64	0.94	—
4	Iron and Steel Scrap	—	47.8	50.0	2.2	16.7	11.5	3.50	1.96	2.66	0.030	0.040	1.11	3.87	1.91	1.90	28.5	0.014	0.040	0.96	2.00	1,500
5	Steel Scrap	—	—	97.6	2.4	22.0	12.0	2.20	0.35	2.17	0.050	0.050	0.40	3.64	3.29	1.76	19.0	0.020	0.050	0.35	2.25	1,525

* Expressed as per cent. of metal charge. All other entries per cent. except where otherwise stated. † Of original percentage.

Mixture 2.—This represents a charge in which a greater proportion of coke was used giving more reducing conditions, and the flux proportioned to provide an intermediate range of slab basicity (CaO/SiO_2 ratio 0.95). Under these conditions additional carbon pick-up was obtained and the sulphur pick-up held within reasonable limits, making possible a substantial replacement of pig-iron by steel and iron scrap.

Mixture 3.—This represents a charge consisting mainly of iron scrap with sufficient steel to hold the carbon content of the tapped metal in the desired range. With coke proportions similar to those of the previous melt and slag basicity in the intermediate range, the sulphur content of the metal was held to the required limits. Repeated melting of such a charge in conventional acid-slag practice would result in progressive sulphur pick-up.

Mixture 4.—This represents a scrap melt carried out with highly-basic slag (CaO/SiO_2 ratio 2.00) which promotes carburization of the steel scrap to pig-iron levels with marked desulphurization to 0.014 per cent.

Mixture 5.—This represents an all-steel-scrap charge carburized and desulphurized by use of a highly-basic slag, together with a high percentage of coke to create the necessary reducing conditions and to provide carbon for carburizing. It is apparent from the above melts that the water-cooled cupola can be operated with basic slags, and with results similar to those obtained in a fully basic-lined cupola.

Furthermore, slag composition can be varied through a range of basicity to carburize and desulphurize scrap charges, the application of hot blast facilitating the operation when use is made of the more viscous basic slags. The observations relating to carbon and silicon fluctuations noted in the section of this report dealing with the basic cupola still apply when melting with hot blast and water cooling, and the high silicon loss associated with basic melting still pertains with hot-blast operation.

The application of extensive water-cooling virtually solves the refractory problem, making possible much longer melting campaigns and greatly reducing the down-time for repairs. The use of hot blast compensates for the heat lost by water-cooling and fuel economy becomes of secondary importance to the metallurgical effects obtainable.

In issuing this first report, the sub-committee is conscious of many individual aspects of the reported developments which could usefully be studied. It has been considered desirable to report results currently being obtained, because this approach may serve to attract more workers into this field of investigation.

The sources from which the sub-committee has been able to draw information have proved to be limited and a continuation of the work of the sub-committee will be helped considerably if more active work is undertaken by individuals and firms and the results made available to the sub-committee.

Acknowledgments

The sub-committee wishes to express thanks to all the firms who have representatives serving among its members, and particularly to the Austin Motor Company, Limited, Butterley Company, Limited, Britannia Iron & Steel Works, Limited, Cochranes (Middlesbro') Foundry, Limited, Dartmouth Auto Castings, Limited, Ford Motor Company, Limited, John Harper & Company, Limited, Qualcast, Limited, Stanton Ironworks Company, Limited, and West Yorkshire Foundries, Limited, for the information placed at the sub-committee's disposal.

REFERENCES

[8] Bamford, B.I.S.R.A. "Conference on Cupola and Converter Refractories," FOUNDRY TRADE JOURNAL (May 19, 1949).
[9] J. W. Dews, "Design, Installation and Operation of a Water-cooled Cupola," FOUNDRY TRADE JOURNAL (May 7-14, 1953).
[10] E. S. Renshaw and S. J. Sargood, "Some Modifications in Cupola Design," I.B.F. *Proc.*, 1950, vol. XLIII.
[11] E. S. Renshaw, "Basic Cupola Process for Desulphurization," FOUNDRY TRADE JOURNAL **70** (June 24, 1943).
[12] Heiken, "Production Results with a Basic-lined Cupola," FOUNDRY TRADE JOURNAL **72** (March 2, 1944).
[13] Second Report on the Basic Cupola, *Proc.* Institute of British Foundrymen (1945-46).
[14] A. F. S. Carter, "Basic-lined Cupola for Iron Melting," *Transactions*, **58**, 376-392 (1950).
[15] E. S. Renshaw, "Basic Cupola Melting and Its Possibilities," FOUNDRY TRADE JOURNAL (August 23, 1951).
[16] W. W. Levi, "Basic-lined Water-cooled Cupola at Lynchburg Foundry," FOUNDRY TRADE JOURNAL (January 10, 1952).
[17] Doat and De Bock, "Metallurgical Blast Cupola," *Proc.* A.F.S., 1952.

More Accident Cases

For some reason not apparent, there has recently been a spate of industrial accident cases dealt with in the Courts. Several are collected in what follows —not for their macabre interest, but because there is a moral in each report, usually for the inculcation of greater awareness of accident potential.

Moulder Awarded £489

At Leeds Assizes, on July 6, Mr. Justice Parker awarded damages of £489, with costs, to Ernest Hyde, aged 66, iron moulder, of Huddersfield, for injuries sustained in an accident at the works of J. Haigh and Sons, Limited, machine makers, Priestroyd Ironworks, Huddersfield, on February 11, 1952. Hyde was filling a small ladle with molten metal from a furnace when his left foot was trapped and he fell to the ground, sustaining bruises to hands and arms.

60-Year-Old Workman Loses Case

At the West Riding Assizes at Leeds on July 9, Mr. Justice Pilcher rejected a claim for damages by Robert William Braithwaite, a turner, who sustained a broken ankle when working for the defendants, the English Steel Corporation, Limited, Sheffield, in 1952. While turning a 40-ft. shaft, weighing 15 tons, Braithwaite slipped and fell backwards. Prior to the accident he had been earning £9 11s. 7d. but his capacity to work overtime had been reduced by the accident. The Judge said that Braithwaite was obviously a responsible workman, and it was impossible to come to the conclusion that the Corporation were guilty of any lack of reasonable care in the working system.

Molten Metal Claims

At Dover County Court on July 7 three compensation claims by moulders were heard by Judge John Neal. John Gibbs claimed £200 for damages to his feet, burnt in an accident at the foundry. Terms were agreed that a payment of £150 with costs should be made. Geoffrey Tatley claimed £60 for injuries to his eye from molten metal which spat from a moulding box, alleging that owing to the positioning of the pattern in the box there was not enough room to pack sand to stop leakage. Agreement was reached that a payment of £40 with costs should be made. John Wainwright claimed damages from an accident when the bottom fell out of a ladle. This case was adjourned.

Unfenced Machinery

At Halifax, West Riding, Court, last week, a fine of £15 was imposed on James W. Simpson and Son, Limited, joiners and contractors, Parkside Joinery Works, Elland, who pleaded "guilty" to failing to have machinery efficiently fenced. Mr. Joseph A. Davis, factory inspector, said that on April 28 Kenneth Doyle had lost the third finger of his left hand while using a machine. At Bingley Court, a fine of £20 was imposed on the worsted spinning firm of Abram Ambler and Sons, Limited, for contravening the Factories Act, 1937, which required that every dangerous part of any machinery should be securely fenced. A further fine of £10 was imposed for not having every part of transmission machinery securely fenced. The firm, pleading "guilty" to both offences, was also ordered to pay 7s. costs. The case arose from an accident in which an employee, Mrs. Martha A. Whalley, received injuries while working on a French drawing machine; which necessitated the amputation of fingers. In the second offence there was no accident, but when the Factory Inspector visited the factory on June 11 she saw a carding machine on which the driving belt and pulleys were unguarded and the machine was in motion at the time.

Meehanite Research Conference

The 22nd annual conference of the International Meehanite Research Institute was held at the Grand Hotel, Brighton, from June 22 to 24, and the preliminary business session included the secretary's and treasurer's report. Representatives from Great Britain and European countries were present and the subjects discussed covered a wide range of ironfoundry activities. The conference opened under the presidency of Mr. W. H. Harper, of John Harper (Meehanite), Limited, who welcomed new members. In his address he referred to the widespread activities of the Meehanite Institutes all over the world, emphasizing the importance of continued research in maintaining progress and achievements, and stressing the need for combined research effort through the Institute. Each member firm, he continued, should have one responsible executive who would be primarily concerned with research, in co-operation with the other members of the Institute. He gave as an example of this co-operation the fine results obtained in operating the Meehanite foundry school.

The chairmen of the various committees then gave an account of their work during the year. For the technical research committee, Mr. E. Walker presented the report and gave an account of work in progress. The secretary described Meehanite branch institute conferences held in Scandinavia and Italy during the year, also, the foremen and metallurgists' conference held in Cardiff last October and the visit to Goulds Foundries, Limited, at Newport. The satisfactory progress of the Meehanite Apprentice Training School at the Butterley Company's works at Derby was reported on by Mr. J. E. Spear for the educational and training group. Dr. N. E. Rambush gave an account of the work done by the production and development committee.

Technical Session

The technical session then opened under the chairmanship of Mr. Oliver Smalley, who dealt in the first place with casting service records which are compiled and distributed among members. He pointed out the importance to the foundry of knowing the properties of castings as engineering materials and said that these properties should be known by the salesmen also.

Subjects listed for discussion in this session included machinability; savings through layout and methods; foundry organization, shell moulding, production control and apprentice training. In the management session, under the chairmanship of Mr. W. H. Harper, subjects discussed included the establishment of cost-control standards and economies in quality control. The foundry and metallurgical session was presided over by Mr. W. R. Blakeborough and reports here took in gating for production, skin drying of large moulds, micro-hardness of Meehanite, cupola design, and water-cooling, melting control, basic-cupola experiences, ladle linings, modulus of elasticity, etc.

The annual dinner was held on the evening of June 23 and was presided over by Mr. E. M. Currie, who welcomed the members and reviewed the work and growth of the Institute. The toast to the Institute was proposed by Mr. P. Tromans and responded to by Mr. Oliver Smalley. The toast to the visitors from abroad was proposed by Mr. Wilfred Harper.

B.C.I.R.A. Open Day

Pleasing Informal Occasion at Alvechurch

On July 7, the British Cast Iron Research Association at its Bordesley Hall, Alvechurch, headquarters was "at home" to members and guests, about 300 of whom attended. Following assembly and preliminary visits to the laboratories—from 11 a.m. onwards—there was a buffet luncheon for those present, arranged in a marquee in the grounds in front of the Hall. Afterwards, the visitors were addressed by Sir Frederick Scopes, president of the Association. In welcoming them, Sir Frederick said he was particularly pleased to see so many young foundrymen present, for it was upon their shoulders that the responsibility for supporting the Association would ultimately devolve. Amongst other items, he disclosed that the Department of Scientific and Industrial Research had offered to continue financial assistance to the Association for a further period of five years. He also said that Sir Lincoln Evans from the Iron & Steel Board had been invited to join the Council of the Association and had accepted. Members were enjoined to co-operate fully with the researches being carried on and asked to indicate which, in their opinion, should be given priority.

It will be remembered that at the last "open day"—some two years ago—there was much new plant and apparatus to be seen. This year, there was less new in the way of equipment, but many new uses and developed applications for that already installed. For instance, the research into the "hot" properties of moulding sands on apparatus designed and built domestically is beginning to show results of practical value; the Quantometer, too, is now in regular use.

Each department had something special to show and exhibits were well annotated and tastefully arranged. Perhaps the most difficult to illustrate in this way was the work of the intelligence department, yet here use was made of charts showing publications issued, reviewed and abstracted; landmarks in ironfounding—including *le dernier cri*, the sodium-silicate/CO_2 process for setting moulds and cores—as well as the way of dealing with typical enquiries. The many aspects of the "pure research" undertaken at Alvechurch attracted the major interest of visitors and chief amongst these the writer would place the researches on physical properties of nodular cast iron—where knowledge threatens to outstrip that on ordinary iron—; influence of the mould on the soundness of the casting; surface finish; heat transfer, and the like.

Equipment in the "foundry" section of the laboratories has been augmented by a new moulding machine and the rocking-arc furnace has been turned into a metal/slag reaction chamber. The new foundry building, now completed, at present houses the equipment for research on certain aspects of foundry dust control; it is hoped that the major work on this subject at Alvechurch will soon be completed.

Specially-built Equipment

Designing, re-designing and building of specialized apparatus domestically has long been a feature of the Association's work, and is exemplified in many sections. Pioneers in any sphere rarely have suitable tools ready fashioned at hand, and making their own, though it may introduce initial delay, yet promotes mastery of a project in the end. At very least, it breeds ingenuity, resourcefulness and vision, so providing the right atmosphere in which those who are research minded can flourish.

The metal, sand, dust, foundry and other research sections all need backing up with services provided by chemical and engineering laboratories, etc., and this aspect of individual development and mutual service is very happily blended at the B.C.I.R.A. laboratories—in fact it provides a model in teamwork for other associations. The "open day" showed that, over the years, a most comprehensive organization has been built up of immense capacity, and one of which the industry can be very proud.

An unusual addition to the technical displays consisted of some 70 examples of art castings in iron. They included specimens of "Berlin" iron, the finely executed iron jewellery made in the Prussian capital in the early 19th century. A modern German specimen in the same tradition was shown, this being a small butterfly brooch weighing 3.5 gm. and said to contain 250 holes. German ironfounders apparently have a habit of sending each other iron "New Year" cards bearing religious or symbolical designs, and some of these were shown by Dr. J. G. Pearce, the director, in his office which was turned into a display room for the occasion. Included was a cast-iron statue of St. Barbara, patron saint of miners, foundrymen and engineers. Other art castings were loaned by a number of ironfounders who collect them.

This year, the exhibits were kept up for the following day also, when delegates from other research associations and scientific bodies, Government laboratories, users of castings, etc., were invited. On that occasion, a further 150 visitors were received in the same informal way and given the freedom of the premises. The director and his staff are to be congratulated on the undoubted success of the whole arrangements.

British Goods in South America

Sir George H. Nelson, chairman of the English Electric group, who has just completed a 20,000 miles tour of Central and South America and the Caribbean area, emphasized wherever he went that the real resources of Britain were the special flair of her people for scientific research and technical achievement, and their skill and experience in making things that the world needed. Through these he believed we could contribute to the well-being of other countries that had great natural resources. We could supply goods which were completely competitive with the products of the industrial nations of the world in price and delivery. The quality of British manufacturers had always been unsurpassed.

Sir George's tour was sponsored by the Treasury, the Board of Trade, the Ministry of Materials, the Foreign Office, and the Federation of British Industries, and lasted 14 weeks. He found that many people overseas were not fully informed about the problems which Britain had had to overcome during the post-war period in order to reach the stage where she could regain her position as a fully exporting nation. He found also that the marked improvement in the deliveries that British industry could now offer was not fully realized. A thing that impressed him greatly was the favourable attitude towards Britain and British manufacturers that he found among all the leading personalities in Government and industrial circles.

The importance of British representatives being not only highly qualified technically but also skilful salesmen with a sound knowledge of the Spanish and Portuguese languages, became abundantly apparent during Sir George's tour. Given these qualifications among overseas representatives of industry there seemed to be no reason why British goods should not have an immediate and assured market on an increasing scale.

Personal

MR. JOHN JOHNSTON has retired after 33 years' service in the pattern department of Chattan Foundry of Mitchell, Russell & Company, Limited. He was presented with a wallet of notes by his colleagues.

MR. CHARLES STOKES is relinquishing his position as secretary of Thos. Firth & John Brown, Limited, the Sheffield steelmakers, but will continue as an executive director, with special responsibilities concerning financial matters. He will be succeeded by MR. R. M. N. GRAY.

MR. ALAN RODERICK ABRAHAM has been appointed a borough magistrate at Mansfield, he is a director of the Mansfield Standard Sand Company, Limited. During the war he was in charge of a foundry at Huddersfield and he has had engineering experience with a number of East Midland firms.

MR. R. H. GARNER, principal of the School of Engineering, Burnbank, Hamilton, is going to France in November as one of the Scottish representatives attending a teaching course arranged by the French Government at Sèvres, near Paris. The course will deal with the training of apprentices. Those attending will visit technical colleges, works, schools, and apprentice training centres.

MR. BROOKS MCCORMICK has resigned as managing director of the International Harvester Company, Limited of Great Britain in order to take up executive duties with International Harvester in Chicago. Mr. McCormick will continue as a director of the British company. MR. OMER G. VOSS, formerly assistant managing director, succeeds him.

MR. J. D. HULLOCK, foundry manager of Sheepbridge Stokes, Limited, who is leaving to take up a new position with the Clay Cross Company, Limited, received a barometer from the foremen and staff of the foundry departments. It was presented by Mr. John Morton, assistant foundry manager. From Mr. J. H. Lomas (managing director, Northern Group) he received a canteen of cutlery on behalf of the management and executives of Sheepbridge Engineering, Limited, and from fellow employees of the foundry departments he was presented with a brief case by Mr. Albert Carter (senior cupola tenter).

AFTER MORE than 38 years' service with the Metropolitan-Vickers Electrical Company, Limited, Trafford Park, Manchester, MISS G. L. ENTWISLE, who was one of the first women electrical engineers in this country has retired. In 1915, when she joined the technical staff of Metro.-Vick. from Manchester University, where she studied physics, she was the first woman to be so employed, and later had the distinction of becoming the first woman student, then graduate, and finally an associate member of the Institution of Electrical Engineers. From 1941 to 1943 Miss Entwisle was president of the Women's Engineering Society.

THE APPOINTMENT is announced as general manager of the Briton Ferry Steel Company, Limited, of MR. JOSEPH NEEDHAM KILBY, who joined the company 10 years ago as personal and technical assistant to the chairman and adviser of production and technical policy after the changeover from tin-plate to the manufacture of steel billets for the Midland re-rolling trade. Mr. Kilby was then also retained as a consultant by several other steel companies, but four years ago he dropped all other appointments to concentrate his activities with the Briton Ferry Steel Company. He is also a director of the company's subsidiary, London Works (Barlows, Limited), Birmingham.

Obituary

Mr. E. D. MCCALLUM, Reader in Industrial Organization at King's College, Newcastle-upon-Tyne, has died at the age of 56.

Mr. C. W. D. ROWE, deputy-chairman and a managing director of the London Brick Company, Limited, and a director of Transformers (Watford), Limited, died recently.

TOM REYNOLDS & SON, announce the death on July 4 after a short illness of their junior partner Mr. T. W. Reynolds. He served an apprenticeship course with Newton Chambers & Company, Limited at Thorncliffe, before doing his National Service. He then joined his father in the family business of Tom Reynolds & Son, ironfounders and engineers, Little Harrowden, nr. Wellingborough, only 18 months ago, and became a partner in March of this year.

MR. DAVID MORRISON MCQUEEN, who died recently at the age of 74, was a native of Falkirk and a well-known executive in the English light castings industry. He was a prominent evening-class instructor in iron-moulding in the former Science and Art School, Falkirk, and was moulding-shop foreman in Laurieston Foundry when, in 1923, he was appointed foundry assistant manager at Essex Works, Aston, Birmingham, of John Wright & Company, Limited. The following year, on the death of Mr. James Brant, Mr. McQueen became foundry manager at Wright's works. He held the position until his retirement five years ago. Subsequently, he resumed as a consultant and as such was serving with the firm at the time of his death.

The death occurred recently of SIR GEOFFREY DUKE BURTON, chairman of Dennis Bros., Limited, commercial motor manufacturers, of Guildford (Surrey), and of Blaw Knox, Limited, steelworks and furnace equipment manufacturers, of London, S.W.3. He was 61. From 1927 to 1930 Sir Geoffrey was general manager of the Metropolitan Carriage Company, Limited, and from 1930 to 1934 he served as managing director of Round Oak Steel Works, Limited. In 1934 he was appointed managing director of the Birmingham Small Arms Company, Limited, which firm gave him leave of absence in 1940 so that he might accept the invitation of the Minister of Supply to become Director-General of Mechanical Equipment, a position he held until 1945. He received his knighthood in 1942. Sir Geoffrey had also served on the Boards of William Jessop & Sons, Limited, the Sheffield steelmakers, Lodge Plugs, Limited, the Earl of Dudley's Baggeridge Colliery, Limited, and Rubberoid Company, Limited.

Honourable Retirement

Reputed to be the world's oldest machine-tool still working, a wall-planer at the Soho Foundry Works of W. & T. Avery, Limited, is to be honourably retired and presented to the Birmingham Museum of Science and Industry. The machine was not new when it was installed at the Soho Foundry in 1848 and in 1890, after 42 years' of continuous working it was considered that a replacement should be prepared for the original hand-cut driving screw. As it happened, the replacement was kept in reserve for 35 years before it was put into use in 1925. Since that date, the original screw has been displayed in a glass case over the machine, and has attracted the interest of visitors from all parts of the world.

News in Brief

THE TECHNICAL DIVISION of the Swedish foundry employers' association is to hold a meeting at Eskilstuna on September 12 and 13.

LAST WEEK, as guests of the firm, 520 employees of Taylor Bros. (Sandiacre), Limited, railway engineers and ironfounders, visited Blackpool on their annual outing.

MR J. WRIGHT, O.B.E., director and general manager of the Dunlop Rim and Wheel Company, Limited, Coventry, has been appointed a director of the Dunlop Rubber Company, Limited.

THE Standard Railway Wagon Company, Limited, Reddish, Stockport, has arranged to purchase the share capital of the L & Y Wagon & Engineering Company, Limited, Heywood (Lancs).

BRITISH INSULATED CALLENDER'S CABLES, LIMITED, announce that Mr. W. G. Dumville, M.C., T.D., has been appointed regional manager, North East, to succeed Mr. E. Charlton, who is retiring.

MAJOR A. G. FREEMAN, works director of Hadfields, Limited, steel manufacturers and engineers, Tinsley, Sheffield, opened the firm's gala and sports day on the Bawtry Road ground, Sheffield, early this month.

A PHOTOGRAPHIC EXHIBITION has been opened in the central canteen of the Staveley Iron and Chemical Company, Limited, in which many well-known personalities of the firm are featured, as well as famous Derbyshire landscapes.

MR. J. F. RILEY of The Mint, Birmingham, was elected president of the Birmingham Junior Chamber of Commerce on July 5. Other officers were, as *senior vice-president*, Mr. D. G. I. MacDonald, as *hon. secretary* Mr. C. E. Hewlett, and as *finance officer* Mr. R. M. Batkin.

A £6,628,000 CONTRACT has been obtained by the English Electric Company, Limited, for the supply and construction of extensions to the St. George's Bay power station, near Athens. It is expected that this contract will mean more work for the Stafford, Rugby, and Liverpool factories of the company.

MR. F. B. HOLT, M.I.E.E., local director, Higgs Motors, Limited, Birmingham 6, is visiting Canada in the late summer. During his stay he intends visiting existing agents and customers. Anyone wishing to make contact with Mr. Holt can do so through head office or the U.K. Trade Commissioners in Canada.

A NOTICE outside the works of W. F. Hadley, Limited, Birmingham, last Wednesday, read: "Skilled toolmakers wanted. No one under 60 years of age." Mr. S. A. Alpen, the general manager, said that they felt there was room for the older men. They might be a bit slower, but they were still the real craftsmen.

MIDLAND SILICONES, LIMITED, 19 Upper Brook Street, London, W.1, discussing the article by Dr. B. Waters describing the "D" Process, state that difficulties encountered in effecting release of the "green" core from the matchplate can be solved by spraying the plate with a solvent solution of a silicone fluid.

AN INCREASE of 65,128 tons in the volume of Tees imports during May, which raised the total to 426,433 tons, is officially attributed to the expansion of incoming shipments of iron ore, coal, and scrap. Tees exports, amounting to 142,884 tons, were also up by 12,772 tons, due primarily to bigger shipments of coal and steel.

CANADA'S DESIRE to increase her trade with Britain was emphasized by Mr. Peter Thorneycroft, President of the Board of Trade, when he addressed a Dominion Day dinner in London at the Canada Club. He declared that it was certainly the U.K. Government's "firm intention to lift restrictions as and when our dollar balances improve."

AN EXHIBITION of the work in progress may be seen during a series of Open Days to be held at the Chemical Research Laboratory, Teddington, Middlesex, from Tuesday to Thursday, September 28 to 30. Applications from industrial firms for invitations to the sessions, should be sent to the director not later than August 31. Firms already on the mailing list need not re-apply.

THE METAL PHYSICS COMMITTEE of the Institute of Metals is proposing to hold in London a one-day symposium on "The Mechanism of Phase Transformations in Metals," at a date which will probably be in November, 1955. Persons wishing to contribute are invited to send title and a brief summary to the Editor, Institute of Metals, 4, Grosvenor Gardens, London, S.W.1.

THE Scottish Fuel Efficiency Committee has written to the N.C.B. urging the introduction of seven differently coloured grades of coal—red, white, grey, blue, green, brown, and black—to ensure that the consumer receives the colour he orders. The committee suggests that the coal be washed in these colours, which would come from a clay substance. Several European countries have already introduced this system of grading.

A DANISH TRADE DELEGATION in Moscow is reported to have reached a trade agreement with the Russian Government which is expected to provide for exports in excess of 300,000,000 kroner (£15,000,000). Under the agreement, Russia is to send tractors, 300 cars, crude iron, fuel oil, silver, and gold to Denmark. In return she is to receive agricultural products, fish, ships (including refrigerated ships), and industrial machinery.

THE ENGINEERING DIVISIONAL COUNCIL of the British Standards Institution will consist of Mr. S. J. Harley, chairman; Mr. W. R. Beswick; Mr. C. Humphrey Davy; Mr. O. W. Humphreys; Professor A. J. Murphy; Mr. F. J. Saniter; and Sir Ewart Smith. The Council has nominated the Lord Dudley Gordon, D.S.O., Mr. M. W. Kendall and Sir Philip Warter as its representatives in the General Council of the Institution.

MANY DOLLAR ORDERS from American and Canadian buyers may be placed with Finlay Engineering, Limited, Newport (Mon), following the company's exhibition of a hydraulic girder-bending machine at the international trade fair at Toronto. The machine, which was the only one of its kind in the show, aroused a great deal of interest, and the Finlay stand had a 30-sec. showing in the Canadian Broadcasting Corporation's television newsreel.

A MAJOR BREAKDOWN has occurred in a £3,000,000 blooming and slabbing mill at the works of the Consett Iron Company, Limited, Consett (Co. Durham). Repairs will take at least three weeks, and in order to prevent as little disruption as possible, the company suggested that the employees should take their two weeks' annual holidays immediately, while repairs were being carried out, and not wait until the end of July when the holidays were due to start. The firm's 3,000 employees agreed.

THE APRIL (1954) STATISTICS for pig-iron and steel production quoted in last week's issue on page 56 were wrongly annotated. Correctly given, the Tables should be referred to as follow:—Table I summarizes activities in the previous six months; Table II production of steel ingots and castings in April; Table III deliveries of finished steel in March; and Table IV

News in Brief

production of pig-iron and ferro-alloys in April, and furnaces in blast. Apologies are tendered to readers who were confused.

THE FIRE-FIGHTING team of W. Jessop & Sons, Limited, founders and steel manufacturers, Brightside Works, Sheffield, gained the highest aggregate of points in fire-fighting competitions on July 3 organized by the Sheffield and District Works and Private Fire Brigades Associations. Other winners were J. Parkinson & Son, Shipley, Yorks, and the Sheffield firms: Edgar Allen & Company, Limited, Samuel Fox & Company, Limited, Hadfields, Limited, Laycock Engineering Company, Limited, and Cravens, Limited.

ABOUT 2,500 PEOPLE attended the Gala Day and Sports on Raynesway, Derby, which was organized by the welfare department of Aiton and Company, Limited, pipe founders and engineers, of Stores Road, Derby. By invitation of the management, many staff from outside branches were present, also 40 retired employees and their families. The competition prizes were presented by Mrs. Aiton, wife of Wing Commander J. M. Aiton, chairman of the directors. The foundry department won the tug-of-war competition.

50,000 TONS of scrap metal is expected to be secured from 72,000 tons of shipping which Thos. W. Ward of Sheffield now have lying at their shipbreakers' yard at Inverkeithing on the Firth of Forth. This is in addition to machinery, fittings and other material. The five ships are H.M.S. Formidable, 23,000-ton aircraft carrier, H.M.S. Resource, 12,300-ton naval depot ship, s.s. Maloja, 21,000 tons, s.s. Mulberra, 9,000 tons, and British Courage, a 7,000-ton tanker. Since 1894, the firm has broken up in their six yards 377 warships and 1,430 merchant ships.

A SCHEME OF DEVELOPMENT to cost over £20,000,000 is to be undertaken by Colvilles, Limited, at Motherwell, and will provide employment for an additional 700 to 800 workers. The company have announced that they have now received the sanction of the Iron and Steel Board and the Iron and Steel Holding and Realization Agency to proceed with the scheme for the construction of a coke oven, blast furnace and steel-making plant. A contract running to about £2,000,000 has been signed by Ashmore, Benson, Pease & Company, Limited, Stockton, for work on the new plant.

VALUABLE ADDITIONS to work on hand have been acquired by the North British Locomotive Co. Ltd., Glasgow, including new orders for 13 locomotives of varying sizes. Six large steam locomotives (of about the weight of mixed-traffic engines operated on U.K. railways) are to be built for South African coal mines, while two Diesel hydraulic locomotives of 500 h.p. are for copper mines in Rhodesia. Two of this type will also be supplied to a steel company in England. In addition, three small Diesel locomotives for underground operation in mines have been ordered by a Canadian undertaking.

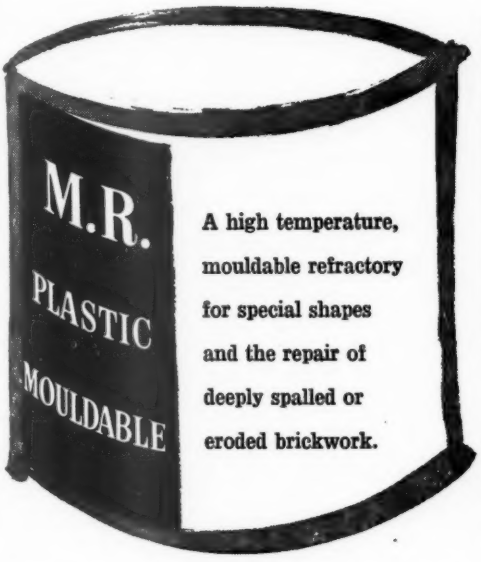
PLANS HAVE BEEN PASSED for an extension, providing for an increase of about 25,000 sq. ft., to the Kelvinside Works of M. & C. Switchgear, Limited, Kirkintilloch, Glasgow. New bays will provide space for an enlarged machine shop, a light fabrication department, and an increased area for the assembly departments. The fabrication department will provide a new trade to the Kirkintilloch district. The cost of the extension and new equipment will be about £50,000. The works will be closed from noon on July 16 until August 2 for staff holidays. A skeleton staff will be available to deal with urgent matters.

Two of football's most coveted trophies—the F.A. Cup and the League Cup—provided an unusual attraction for visitors to the annual sports of Geo. Salter & Company, Limited, of West Bromwich. The showing of the F.A. Cup to Salter employees was particularly appropriate, for West Bromwich Albion, the present holders, grew from a club originally formed by a number of Salter workers in the 19th century. As neighbours and friendly rivals, Wolverhampton Wanderers, League Division I champions, lent their trophy to make an interesting pair. Prizewinners at the sports received their awards from Mr. Ronnie Allen, the Albion player.

THE ALUMINUM COMPANY OF CANADA, LIMITED, have available three 16-mm. sound films, in colour, as below:—"*Packaged Power*"—A feature film on some of the activities of the Group throughout the world (running time: approximately 35 minutes); "*Prelude to Kitimat*"—The latest available version on the Company's British Columbia development (running time: approximately 25 minutes); "*Man with a Thousand Hands*"—This film, produced by International Harvester Company, Limited, gives a full picture of the various phases of the Kemano-Kitimat development with special reference to the engineering and constructional problems involved (running time: approximately 55 minutes). Details can be had by writing to Stand Limited, 11 Bruton Street, London, W.1.

DAMAGES of £357 2s. 6d. were awarded against Guest, Keen & Nettlefolds (Midland) Limited, of Smethwick, at Staffordshire Assizes on July 9, to Denis James Peat, a machine setter who received injuries to his wrist in 1952, while engaged in finishing off a component on a new lathe. As he was withdrawing from a glove which had caught up in the mechanism, the cutter severed three tendons and fractured the wrist, it was stated. Peat said that the firm had not given him enough instruction about the safest method to use. The firm denied negligence and stated that the wearing of gloves was unnecessary and that Peat failed to exercise proper care for his own safety. Mr. Justice Lynskey found that although there had been no breach of statutory duty under the Factories Act, there was one under Common Law. The employers had adopted a dangerous system of work and had not taken reasonable care for the safety of their employee, he said.

A BROCHURE entitled "The Four-way Service," which is to be published shortly by the National Industrial Fuel Efficiency Service, outlines the service offered to industrialists in the way of eliminating waste that occurs in the generation of heat and power. It is stated that it is not known widely enough that the correct use of fuel, heat, and power can lead to greater savings through smaller fuel bills, increased productivity, and lower manufacturing costs. Experience has shown that for every 1 per cent. of saving gained from improving the burning of fuel itself, four times as much saving is usually achieved by correcting steam-transmission systems, processing equipment, and space-heating arrangements. The directors of N.I.F.E.S. are satisfied that if every point at which waste can occur were subjected to regular routine inspection and simple measures were taken to remedy defects the total savings in fuel would be spectacular. A reduction of 20 per cent. in fuel bills was the target that most firms could attain.


M.R.
PLASTIC
MOULDABLE
A high temperature, mouldable refractory for special shapes and the repair of deeply spalled or eroded brickwork.

The chief characteristics of this material are very high refractoriness, good volume stability at high temperatures and loading, and freedom from spalling. In certain circumstances its performance is superior to that of pre-fired high-alumina shapes—and it is in all circumstances easy to use. It is particularly useful for burner ports, inspection and access doors in high temperature furnaces: for forming special shapes *in situ;* for heavy repair work and crucible furnace linings.

Approximate Analysis

Alumina Al_2O_3	60%
Silica SiO_2	36%
Ferric Oxide Fe_2O_3	1.3%
Alkalis	1.0%

Physical Characteristics

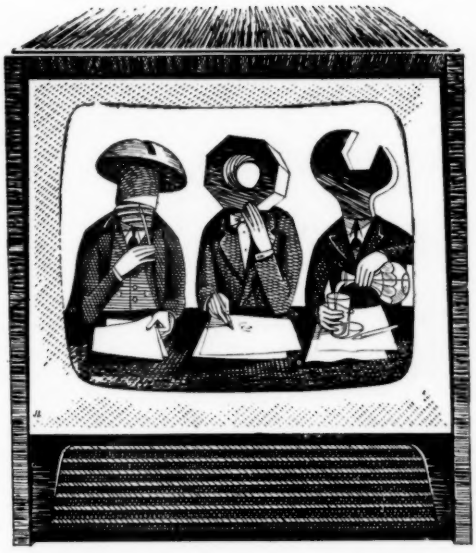
Maximum service temperature	1650°C
Shrinkage: Set to dry	less than 0.75%
Dry to 1 hour at 1620°C:	less than 1.00%
Modulus of rupture	
1 hr. at 1000°C	200lb/sq.in.
1 hr. at 1420°C	450lb/sq.in.
1 hr. at 1620°C	750lb/sq.in.

Other Morgan Refractories include: RC.849—refractory concrete; M.I.22—insulating concrete. The M.I.28—low-storage insulating refractory for temperatures up to 2800°F (1538°C) and M.R.1—super-duty refractory brick which is stable up to 1600°C (2912°F). *Send for Leaflet RD.34.*

MORGAN refractories

ARE WORTH FAR MORE THAN THEY COST

THE MORGAN CRUCIBLE COMPANY LTD. (Refractories Group), Neston, Wirral, Cheshire. Telephone: Neston 1406 N.E.64



What's your line on STEEL

CATHODE RAY TUBES in many of the latest television receivers are made with walls of steel. Very special steel. To this steel the glass screen on which the TV picture appears can actually be joined in perfect fusion.

And the advantages of these steel-welded tubes? They are easier to produce and therefore cheaper. They are stronger, safer to use, lighter in weight and easier to handle. All thanks to steel.

Many special steels have been developed in recent years. Steel is now not only the toughest and cheapest of metals; continuous research has made it one of the most versatile.

In six years since 1947 production of alloy and high speed steels has risen from 623,000 tons to 1,066,000 tons; an increase of over 70%.

STEEL is at your service

THE BRITISH IRON AND STEEL FEDERATION S.75

Imports and Exports of Iron and Steel in May

The following tables, based on Board of Trade returns, give figures of imports and exports of iron and steel in May. For the purpose of comparison, totals for the first five months of this year and last are also included. (All figures in tons.)

Total Exports of Iron and Steel

Destination.	Month ended May 31.	Five months ended May 31.	
	1954.	1953.	1954.
Channel Islands	404	1,527	1,821
Cyprus	983	4,502	3,025
Sierra Leone	182	1,922	5,456
Gold Coast	1,303	15,489	15,591
Nigeria	3,371	17,007	22,696
Union of South Africa	3,291	57,715	16,634
Northern Rhodesia	372	9,136	2,173
Southern Rhodesia	8,363	21,515	21,121
Tanganyika	2,109	6,097	5,859
Kenya	5,921	27,722	29,793
Uganda	394	2,093	3,013
Mauritius	531	3,046	3,198
Bahrein, Qatar, and Trucial Oman	591	10,390	10,859
Kuwait	378	6,780	3,463
India	7,201	22,117	37,565
Pakistan	2,889	11,729	19,640
Singapore	2,339	11,099	12,714
Malaya	2,002	12,105	10,492
Ceylon	2,866	7,363	8,165
British North Borneo	478	1,895	1,652
Hongkong	1,596	12,777	7,702
Australia	21,810	61,285	92,316
New Zealand	16,311	51,496	75,121
Canada	19,388	69,956	78,248
Jamaica	1,384	4,709	6,053
Trinidad	3,012	14,583	16,992
British Guiana	652	2,325	2,135
Anglo-Egyptian Sudan	2,054	10,715	13,835
Other Commonwealth countries	1,554	22,588	12,311
Eire	4,634	15,335	20,374
Soviet Union	—	2	—
Finland	7,619	13,045	25,775
Sweden	5,762	33,172	32,132
Norway	4,734	26,357	32,813
Denmark	8,609	38,003	39,753
Western Germany	280	4,570	2,328
Netherlands	8,400	52,088	40,701
Belgium	863	7,595	4,648
France	474	3,910	2,241
Switzerland	824	3,906	4,572
Portugal	974	7,226	4,693
Spain	398	1,609	1,756
Italy	2,337	19,752	21,967
Austria	20	549	476
Yugoslavia	613	1,214	2,323
Turkey	1,091	5,788	5,203
Netherlands Antilles	345	4,464	1,921
Portuguese E. Africa	233	1,448	1,177
Lebanon	195	2,530	763
Israel	184	2,449	4,200
Egypt	801	11,006	15,498
Saudi Arabia	116	506	1,165
Iraq	2,380	19,688	14,934
Iran	785	1,737	2,559
Burma	1,190	3,472	4,638
Thailand	206	4,419	3,089
Indonesia	1,064	5,814	3,117
Philippine Republic	56	1,016	1,698
U.S.A.	2,341	18,324	10,845
Colombia	277	3,664	2,512
Venezuela	5,016	21,640	16,429
Ecuador	340	1,383	1,312
Peru	1,768	2,997	2,812
Chile	241	789	693
Brazil	39	1,238	286
Uruguay	451	432	7,774
Argentina	4,170	5,456	29,665
Other foreign countries	7,176	14,043	35,658
TOTAL	190,735	864,319	944,143

MR. JOHN IVAN TAYLOR, a director of the foundry firm of James Maude & Company, Limited, has been appointed a borough magistrate at Mansfield.

Total Imports of Iron and Steel

From	Month ended May 31.	Five months ended May 31	
	1954.	1953.	1954.
Canada	1,324	56,488	3,081
Other Commonwealth countries and Eire	4,028	44,531	12,332
Sweden	1,240	7,856	12,951
Norway	2,145	24,769	11,498
Western Germany	154	19,875	39,664
Netherlands	9,109	52,181	43,405
Belgium	2,043	111,519	20,196
Luxembourg	689	57,614	8,801
France	2,127	135,859	31,197
Italy	—	12,740	2,689
Austria	22,807	175,821	98,320
Japan	30	55,112	45
U.S.A.	1,571	96,184	37,665
Other foreign countries	22,150	26,293	85,500
TOTAL	69,417	876,842	407,344
Iron and steel scrap and waste, fit only for the recovery of metal	58,262	313,668	342,355

Exports of Iron and Steel by Product

Product.	Month ended May 31.	Five months ended May 31.	
	1954.	1953.	1954.
Pig-iron	1,930	2,519	5,819
Ferro-tungsten	151	24	307
Other ferro-alloys	617	1,142	4,672
Ingots, blooms, billets, slabs, sheet and tinplate bars	7	221	1,258
Iron bars, rods, and sections	239	1,031	1,117
Steel bars, rods, sections, and shapes	28,021	122,954	123,504
Iron plates and sheets	11	171	324
Universal plates	213	5,480	2,547
Steel plates, ¼ in. and under ⅜ in.	1,571	3,667	5,220
Do., ⅜ in. and over	10,918	89,833	60,368
Black sheets and black plate	16,612	61,917	83,911
Hoop and strip	5,469	23,536	43,975
Tinplate	22,695	115,434	127,084
Tinned sheets, terneplate, and terne sheets	157	686	1,011
Decorated tinplate	301	657	1,078
Galvanized sheets	10,732	41,794	65,778
Other coated plates and sheets	840	4,462	3,702
Railway and tramway construction material	20,389	107,506	101,517
Wire rods	3,376	5,203	13,526
Wire	8,863	18,984	33,530
Tubes, pipes, and fittings	55,605	251,196	255,027
Iron castings	1,473	2,268	5,630
Steel castings	135	1,160	1,533
Forgings	410	2,474	1,725
TOTAL	190,735	864,319	944,163

MEMBERS of the National Smoke Abatement Society toured the works of Park Foundry (Belper), Limited, and saw at first hand the manufacture of different types of domestic appliances made by this Derbyshire firm to try to stop air pollution. They also visited the foundry, where old-fashioned grates are reproduced and repaired, which is a specialist section. Mr. W. A. Ballard, general manager and a director of the firm, welcomed the visitors.

Zircon

ZIRCOSIL IN FOUNDRY PRACTICE

ZIRCOSIL GRANULAR ZIRCOSIL D
Zircon sand and flour for cores, mould washes ; precision casting investment, shell moulding, permanent ceramic moulds ; pre-treatment of enamelling cast iron.

ZIRCOSIL BLENDED
For high temperature cores.

ZIRCOSIL WASH PASTE
A wash or spray for moulds and cores.

ZIRCOSIL RAMMING MIX
For ramming and patching electric furnace linings.

There is a lively interest in the new applications of zircon and zirconium products in the foundry. Our Technical Development Service will be glad to have your enquiries :

* *By arrangement with the Titanium Alloy Manufacturing Division of the National Lead Company, New York, we are making under licence their range of "TAM" products and represent them in Europe for zirconium metal and zirconium chemicals.*

ASSOCIATED LEAD MANUFACTURERS LIMITED **ZIRCON DIVISION**, CRESCENT HOUSE, NEWCASTLE UPON TYNE, 1

'FULBOND'
TRADE MARK

For sand texture and good skin 'FULBOND' gives the sand smooth texture—the castings good finish

For service and information write to:—
THE FULLERS' EARTH UNION LTD.
Patteson Court, Redhill, Surrey. Tel: Redhill 3521. C.M.F. 12

Raw Material Markets

Iron and Steel

Of all sections of the foundry industry the engineering and speciality foundries continue to be the most favourably employed. The requirements for castings of the motor and allied trades are at a high level, and with the orders which emanate from many other trades, including makers of electrical and power-plant equipment, machine tools, and agricultural implements, steelworks, collieries, etc., the productive capacity of the foundries, although not excessively engaged, is well occupied.

With the work on hand the engineering foundries are able to specify appreciable quantities of pig-iron, the supply of which presents some difficulty. Many of these foundries would like to secure larger quantities of the low- and medium-phosphorus irons than they are at present receiving, and some foundries in the Midlands and further south find it necessary to obtain deliveries from the Scottish furnaces at the increased prices which the extra rail charges involve. Hematite also is difficult to secure in adequate quantities and suitable analyses, particularly from some furnaces.

While the light and jobbing foundries are not so favourably employed, orders now coming to hand show a slight improvement for some castings, although the foundries supplying castings for domestic utensils are still short of work. Fair quantities of high-phosphorus pig-iron are specified and deliveries meet current requirements.

Producing furnaces maintain high levels of output and plentiful supplies of raw materials are available. The demand for basic steelmaking pig-iron shows no diminution, and imported iron is still required to augment home supplies.

There is a good demand for the better and heavier grades of machinery and cast-iron scrap, but the lighter material is in fairly good supply. Foundry and furnace cokes are delivered up to the allocated tonnages, while little difficulty is found in acquiring supplies of ganister, limestone, and firebricks.

Outputs of small steel bars and light sections are on a better scale and for the present, at least, the re-rollers are enjoying much happier conditions, both in regard to work on hand and their ability to secure semi-finished steel. Their demands for steel billets, blooms, etc., are being met by home steelworks.

There is no falling off in the demand for heavy sections, particularly joists, and plates $\frac{3}{8}$ in. thick and under are in keen demand. Heavier plates are easier to obtain. Sheets are still difficult.

Non-ferrous Metals

Prices last week moved within comparatively narrow limits and trading was for the most part decidedly quiet. Tin showed firmness during the first few days, but subsequently lost ground probably owing to some profit-taking. Now that the Geneva agreement has been ratified by a sufficient margin of votes from the consuming and producing countries, there is a natural inclination to take a somewhat bullish view of the outlook for this metal, but it would hardly be right to presume that everything is going to be entirely plain-sailing. No signature was appended by the United States, but there is no reason to expect opposition from that quarter. On the contrary it is known that the unofficial American attitude is at least not adverse to the operation of the buffer pool and the scheme in general, but it must be remembered that America as the world's largest user of tin pulls a very strong oar, and it is only due to her stockpiling policy that the statistical situation is kept in balance. It looks as though the American tin smelter will continue to operate, although at one time there were doubts about this, but it may be that the ownership will pass into private hands. Meanwhile, contracts for supplies of tin concentrates over a 12-month are understood to have been arranged. The great puzzle in tin is, of course, to know how long the U.S. Government intends to pursue its stockpiling policy, but it is reported that the U.S. authority has currently purchased two-thirds of the Indonesian output for this purpose.

Most of the strength displayed by tin last week was in the cash position, which closed £6 higher on balance, while three months was £3 higher, the backwardation widening to £10, which is an unwelcome development. Copper fluctuated very narrowly, with no change in the U.S. price to cause changes here, and on balance cash was marked down 5s. and three months 2s. 6d. Zinc was virtually unchanged apart from a drop of 2s. 6d. in the first-half October position. The contango at the close of business on Friday was 10s. Trading in lead was decidedly quiet, the close at £97 for first-half July and £95 for first-half October showing no change on the week.

Official metal prices were as follow:—

COPPER, Standard—*Cash:* July 8, £239 10s. to £239 15s.; July 9, £240 to £240 5s.; July 12, £240 to £240 15s.; July 13, £239 10s. to £239 15s.; July 14, £239 to £239 5s.

Three Months: July 8, £237 5s. to £237 7s. 6d.; July 9, £237 5s. to £237 10s.; July 12, £237 5s. to £237 7s. 6d.; July 13, £237 to £237 5s.; July 14, £237 to £237 5s.

TIN, Standard—*Cash:* July 8, £758 to £759; July 9, £759 10s. to £760; July 12, £759 to £759 10s.; July 13, £758 to £759; July 14, £758 10s. to £759 10s.

Three Months: July 8, £746 10s. to £747; July 9, £748 10s. to £749; July 12, £749 to £749 10s.; July 13, £748 10s. to £749; July 14, £749 10s. to £750.

ZINC—*July:* July 8, £78 15s. to £79; July 9, £78 12s. 6d. to £78 15s.; July 12, £78 5s. to £78 10s.; July 13, £77 17s. 6d. to £78; July 14, £77 5s. to £77 7s. 6d.

First half October: July 8, £79 5s. to £79 7s. 6d.; July 9, £79 2s. 6d. to £79 5s.; July 12, £78 15s. to £78 17s. 6d.; July 13, £78 to £78 5s.; July 14, £77 12s. 6d. to £77 15s.

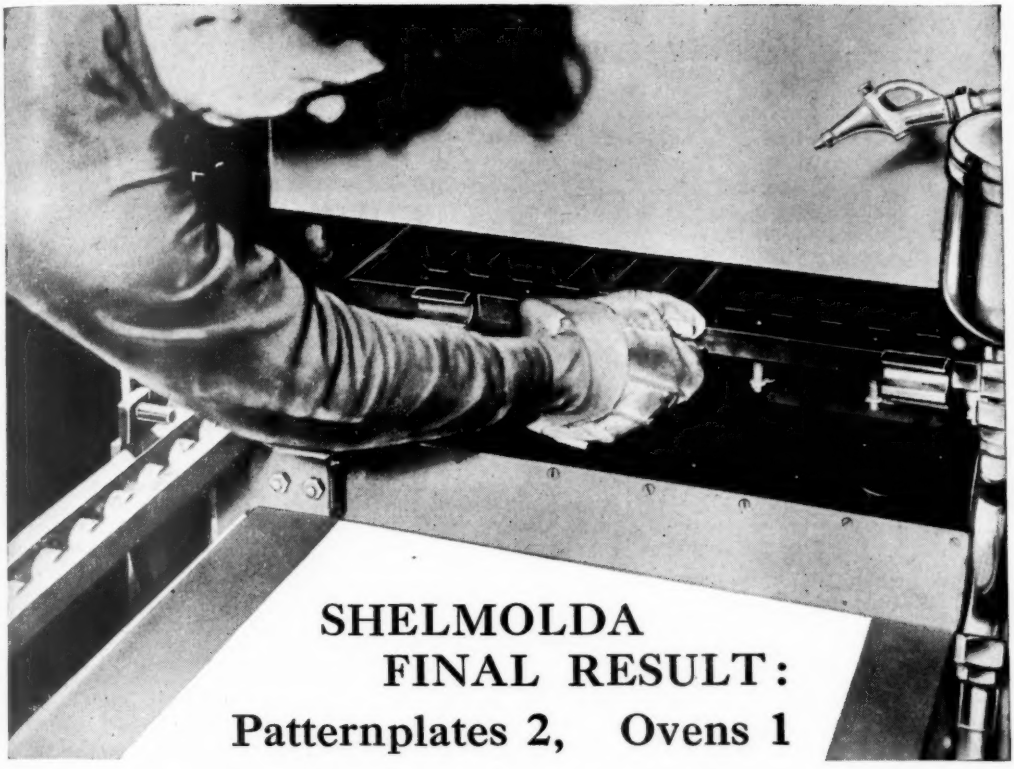
LEAD—*First half July:* July 8, £96 15s. to £97; July 9, £96 15s. to £97; July 12, £96 15s. to £97; July 13, £96 15s. to £96 10s.; July 14, £96 to £96 5s.

First half October: July 8, £94 15s. to £95; July 9, £94 15s. to £95; July 12, £94 10s. to £94 15s.; July 13, £94 to £94 5s.; July 14, £93 15s. to £94.

Latest Foundry Statistics

The Ministry of Supply states that production during April of sand-cast aluminium castings was 1,699 tons, of gravity die 3,511 tons, and of pressure die castings 1,043 tons. During the month 361 tons of magnesium castings were made.

According to the British Iron and Steel Federation, employment in ironfoundries was as at May 8 reduced by 316 to 139,817, or of the male staff by 400. In steelfounding, however, there was a slight rise of 9, bringing the total to 20,101. In May the average weekly amount of steel melted for the making of steel castings was 11,000 tons, as against 9,800 in April and 11,100 in May, 1953.



SHELMOLDA FINAL RESULT: Patternplates 2, Ovens 1

It's a winner, right enough, and here's why:

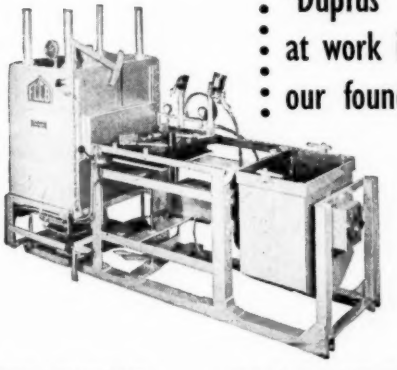
1. The single oven of the Shelmolda Duplus does the work of two. While one shell is being cured the other patternplate is being invested with a new shell.

2. The heat is applied evenly—above, below, at every side. Whatever the depth of pattern, the Shelmolda shell is cured evenly.

3. Production—can you get, anywhere, a greater output with lower running costs at anything like this price?

OUTPUT: 50/60 moulds per hour. *DELIVERY*: 8/10 weeks. *PRICE*: £575

May we show you the Shelmolda 'Duplus' at work in our foundry?



Shelmolda

DUPLUS

(Patent Applied For)

Originated and manufactured by

FAIRBAIRN LAWSON COMBE BARBOUR LTD., LEEDS. ENGLAND

Telephone: LEEDS 32041

236.62

Current Prices of Iron, Steel, and Non-ferrous Metals

(Delivered unless otherwise stated)

July 14, 1954

PIG-IRON

Foundry Iron.—No. 3 IRON, CLASS 2:—Middlesbrough, £14 19s. 6d.; Birmingham, £14 12s. 9d.

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent. P, £17 5s. 9d., delivered Birmingham. Staffordshire blast-furnace low-phosphorus foundry iron (0.10 to 0.50 per cent. P, up to 3 per cent. Si), d/d within 60 miles of Stafford, £17 16s. 9d.

Scotch Iron.—No. 3 foundry, £17 9s. 6d., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, £18 19s. 6d.; South Zone, £19 2s. 0d.

Refined Malleable.—P, 0.10 per cent. max.—North Zone, £19 19s. 6d.; South Zone, £20 2s. 0d.

Hematite.—Si up to 2 per cent., S. & P. over 0.03 to 0.05 per cent.:—N.-E. of England (local iron), £17 14s. 6d.; Scotland (Scotch iron), £18 1s. 0d.; Sheffield, £18 19s. 0d.; Birmingham, £19 6s. 6d.; Wales (Welsh iron), £18 1s. 0d.

Basic Pig-iron.—£15 10s. 6d. all districts.

FERRO-ALLOYS

(Per ton unless otherwise stated, delivered)

Ferro-silicon (6-ton lots).—40/55 per cent., £42 0s. 0d., basis 45 per cent. Si, scale 17s. per unit; 70/84 per cent., £65 0s. 0d., basis 75 per cent. Si, scale 18s. per unit.

Ferro-vanadium.—50/60 per cent., 23s. 8d. to 25s. 0d. per lb. of V.

Ferro-molybdenum.—65/75 per cent., carbon-free, 10s. 0d. per lb. of Mo.

Ferro-titanium.—20/25 per cent., carbon-free, £150 0s. 0d. to £165 0s. 0d. per ton; 38/40 per cent., £239 0s. 0d. to £250 0s. 0d. per ton.

Ferro-tungsten.—80/85 per cent., 11s. 11d. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 14s. 11d. per lb. of W.

Ferro-chrome (6-ton lots).—4/6 per cent. C, £75 0s. 0d. to £80 0s. 0d., basis 60 per cent. Cr, scale 25s. 0d. per unit; over 6 per cent. C, £74 0s. 0d. to £76 0s. 0d., basis 60 per cent. Cr, scale 24s. 0d. per unit; max. 2 per cent. C, 2s. 0½d. per lb. Cr; max. 1 per cent. C, 2s. 1d. per lb. Cr; max. 0.15 per cent. C, 2s. 2d. per lb. Cr; max. 0.10 per cent. C, 2s. 2½d. per lb. Cr; max. 0.06 per cent. C, 2s. 2½d. per lb. Cr.

Metallic Chromium.—98/99 per cent., 6s. 3d. to 6s. 9d. per lb.

Metallic Manganese.—93/95 per cent., carbon-free, £225 0s. 0d. to £232 0s. 0d. per ton; 96/98 per cent., £255 0s. 0d. to £262 0s. 0d. per ton.

Ferro-columbium.—60/75 per cent., Nb + Ta, 52s. 6d. to 70s. 0d. per lb., Nb + Ta.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms, and Slabs.—BASIC: Soft, u.t., £25 12s. 6d.; tested, 0.08 to 0.25 per cent. C, £26 12s. 6d.; hard (0.41 to 0.60 per cent. C), £28 0s. 0d.; silico-manganese, £33 16s. 0d.; free-cutting, £28 16s. 6d. SIEMENS MARTIN ACID: Up to 0.25 per cent. C, £32 12s. 0d.; silico-manganese, £34 17s. 6d.

Billets, Blooms, and Slabs for Forging and Stamping.—Basic, soft, up to 0.25 per cent. C, £29 16s. 0d.; basic, hard, over 0.41 up to 0.60 per cent. C, £30 16s. 0d.; acid, up to 0.25 per cent. C, £33 0s. 0d.

FINISHED STEEL

Heavy Plates and Sections.—Ship plates (N.-E. Coast), £31 1s. 6d.; boiler plates (N.-E. Coast), £32 9s. 0d.; floor plates (N.-E. Coast), £32 10s. 6d.; sectional material, N.-E. Coast, £29 4s. 6d.

Small Bars, Sheets, etc.—Rounds and squares, under 3 in., untested, £32 7s. 0d.; flats, 5 in. wide and under, £32 7s. 0d.; hoop and strip, £33 9s. 0d.; black sheets, 17/20 g., £42 1s. 0d.; galvanized corrugated sheets, 24 g., £51 8s. 6d.

Alloy Steel Bars.—1 in. dia. and up: Nickel, £53 8s. 0d.; nickel-chrome, £75 2s. 0d.; nickel-chrome-molybdenum, £84 13s. 6d.

NON-FERROUS METALS

Copper.—Cash, £239 0s. 0d. to £239 5s. 0d.; three months, £237 0s. 0d. to £237 5s. 0d.; settlement, £239 5s. 0d.

Copper Tubes, etc.—Solid-drawn tubes, 27⅞d. per lb.; wire, 268s. 9d. per cwt. basis; 20 s.w.g., 300s. 0d. per cwt.

Tin.—Cash, £758 10s. 0d. to £759 10s. 0d.; three months, £749 10s. 0d. to £750 0s. 0d.; settlement, £750 0s. 0d.

Zinc.—July, £77 5s. 0d. to £77 7s. 6d.; first half October, £77 12s. 6d. to £77 15s. 0d.

Zinc Sheets, etc.—Sheets, 15 g. and thicker, all English destinations, £108 15s. 0d.; rolled zinc (boiler plates), all English destinations, £106 10s. 0d.; zinc oxide (Red Seal), d/d buyers premises, £96 0s. 0d.

Lead (Refined Pig).—First half July, £96 0s. 0d. to £96 5s. 0d.; first half October, £93 15s. 0d. to £94 0s. 0d.

Brass Tubes, etc.—Solid-drawn tubes, 22⅞d. per lb.; rods, drawn, 32½d.; sheets to 10 w.g., 259s. 3d. per cwt.; wire, 30½d.; rolled metal, 245s. 6d. per cwt.

Brass (Brazing).—BS1400, B3 (65/35), £163; B6 (85/15), £208 ; BS249, £175.

Brass (High Tensile).—BS1400, HTB1 (30 tons), £201; HTB2 (38 tons), £210; HTB3 (48 tons), £220.

Gunmetal.—RCH, 3/4 per cent. tin, — ; BS1400, LG2 (85/5/5/5), £198; LG3 (86/7/5/2), £207; G1 (88/10/2/½), £279; (88/10/2/1), £271.

Phosphor Bronze.—BS1400, PB1 (AID released), £290 per ton.

Phosphor Bronze Strip, etc.—Strip, 366s. 0d. per cwt.; sheets to 10 w.g., 388s. 6d. per cwt.; wire, 45⅞d. per lb.; rods, 39¾d.; tubes, 38d.; chill cast bars: solids 40½d., cored 41½d. (CHARLES CLIFFORD, LIMITED.)

Nickel Silver, etc.—Rolled metal, 3 in. to 9 in. wide × 0.056, 3s. 1¾d. per lb.; round wire, 10g., in coils (10 per cent.), 3s. 7d.; special quality turning rod, 10 per cent., ½ in. dia., in straight lengths, 3s. 6d. All prices are net.

Other Metals.—Magnesium, ingots, 2s. 3d. per lb. Antimony, English, 99 per cent., £210 0s. 0d. Quicksilver, ex warehouse, £100 0s. 0d. Nickel, £483 0s. 0d. Aluminium, ingots, £156 0s. 0d.; aluminium bronze (BS1400), AB1, £250; AB2, £258. Solder, brazing, BS1845, 1s. 11d. lb.; granulated, 2s. 2d. lb.

Company News

SENTINEL (SHREWSBURY), LIMITED, Diesel-engine and locomotive manufacturers, etc.—The annual report states that general reduction of profit margins and lessened demand for capital goods have affected the year's trading adversely. The position on machine tools has been more satisfactory and is improving, but recently there has been a substantial reduction in the rate of delivery, required on Government contracts. The volume of work is, therefore, below requirements and every effort is being made to rectify the position.

MORGAN CRUCIBLE COMPANY, LIMITED, London, S.W.11—The chairman, Mr. P. Lindsay, says the company shared in the improved trade towards the end of 1953. In consequence the order-book has a "healthier colour" than at the corresponding time last year. This state, however, is not reflected in the year's sales turnover, which is appreciably less than in 1952-53. The fall in foreign is relatively less than in home sales in spite of the difficulties confronting the British exporter. Group taxed net profit of £677,180 (£707,646), however, is only slightly less than in the previous year.

TIPPER INDUSTRIES, LIMITED—Mr. Harry Tipper, chairman, has summed up prospects by stating: "The sharp recession in trade which I mentioned in my statement last year appears to be passing, although competition remains intense. . . . I am hopeful of the prospects of the current year." The final dividend of 17½ per cent. which maintains the year's rate at 25 per cent. was announced a month ago. Last year's gross trading profit, including sundry income, was £75,526, compared with £54,159 for the previous year, and after all charges, including taxation, the net profits came out at £19,395, an increase on the year of £7,609. One of the subsidiary companies acquired at the end of March, 1953, was the capital of John Knowles (Wednesbury) which Mr. Tipper says should prove a valuable acquisition to the group.

TRIPLEX FOUNDRY, LIMITED—A further diminution of earnings has resulted in the board again having to reduce the dividend in respect of the twelve months to March 31, 1954. The payment this time is 7½ per cent. compared with 9 per cent. for 1952-53 and 10 per cent. for 1951-52. This Staffordshire company is mainly interested in the production of various types of "Triplex" grates and cooking ranges. After providing tax of £13,200, instead of £16,950, the net profit comes out at £8,651 compared with £9,240, which means that the dividend is only just covered. By omitting an allocation to general reserve (which a year ago received £1,000) the company is able to increase the carry forward slightly to £26,488 from £26,293 brought in.

A.B.B.F. Wolverhampton Meeting

A meeting convened by the Association of Bronze and Brass Founders under the advisory service scheme will be held at the Victoria Hotel, Wolverhampton, on Wednesday, July 21, 1954. The purpose of the meeting, in addition to efficiency matters generally, is to comment on actual foundry layouts, plans of which have been previously submitted. It is hoped that much valuable and stimulating discussion will result. Any information which can be brought to the meeting on comparative fuel costs will be welcomed.

LOW PHOSPHORUS
REFINED & CYLINDER
HEMATITE
MALLEABLE
DERBYSHIRE
NORTHAMPTONSHIRE
SWEDISH CHARCOAL

PIG-IRON

WILLIAM JACKS & CO. LTD.
LONDON, E.C.2.
Winchester House, Old Broad Street
London Wall 4774 (6 lines)

FERRO SILICON 12/14%
ALLOYS & BRIQUETTES
N.F. METALS & ALLOYS
LIMESTONE
GANISTER
MOULDING SAND
REFRACTORIES

And at :—

BIRMINGHAM, 2.
39, Corporation St.,
Midland 3375/6

LIVERPOOL, 2.
13, Rumford St.,
Central 1558

GLASGOW, C.2.
93, Hope Street,
Central 9969

NOTICE

Replies to Box Numbers to be addressed to "Foundry Trade Journal," 49, Wellington Street, London, W.C.2.

SITUATIONS WANTED

FOUNDRY MANAGER (40) seeks situation. 25 years' experience in grey and special iron casting production of both a repetition and jobbing character up to 10 tons. Accustomed to working for competitive markets, and being directly responsible to Board, having served 15 years in executive and administrative capacities. Up to date in modern materials and plant developments, shell moulding, materials handling, and foundry layouts. Salary required £2,000 p.a.—Box FM613, FOUNDRY TRADE JOURNAL.

REPRESENTATION required by experienced and fully trained Foundryman, to cover the Southern half of England. Thorough practical and technical knowledge of trade. Capable of working on own account. Interested in foundry supplies, metals, ferrous and non-ferrous, Machinery, and general equipment.—Box RR610, FOUNDRY TRADE JOURNAL.

FOUNDRY MANAGER (35), A.M.I.B.F., requires similar position. Extensive experience in medium and heavy engineering castings. Also non-ferrous first-class knowledge of cupola operation and control, sand control, mechanisation. Able to control men.—Box FM640, FOUNDRY TRADE JOURNAL.

FOUNDRY MANAGER desires change. Experienced in mechanised and jobbing foundries. Buying and Sales experience, with prospect of introducing new business. Midland area. Further details on application to Box FM631, FOUNDRY TRADE JOURNAL.

SITUATIONS VACANT

The engagement of persons answering these advertisements must be made through a Local Office of the Ministry of Labour or a Scheduled Employment Agency if the applicant is a man aged 18-64 inclusive or a woman aged 18-59 inclusive unless he or she, or the employment, is excepted from the provisions of the Notification of Vacancies Order, 1952.

TECHNICAL REPRESENTATIVE required. Practical engineering or foundry experience essential. Applicants must be over 30 years of age. State salary required.—LLOYDS (BURTON), LTD., Wellington Works, Burton-on-Trent.

REPRESENTATIVE required for the sale of Steel Castings in Lancashire and Yorkshire. Applicants must have knowledge of steel founding, and preferably a connection amongst purchasers of Steel Castings.—Applications, in confidence, to the SECRETARY, Samuel Osborn & Co., Ltd., P.O. Box No. 1, Sheffield, stating age, experience, and salary required.

SALES OFFICE ESTIMATOR required for Steelfoundry.—Apply in writing, giving full details of experience, etc., Box SO621, FOUNDRY TRADE JOURNAL.

PROGRESSIVE Manufacturing Company in Lancashire requires a TECHNICAL SALES REPRESENTATIVE, with a good knowledge of the application of synthetic resins in industry generally, and in the foundry trade in particular. The successful applicant should preferably be resident in the Manchester area, and own a car.—Apply in strict confidence, giving age, details of experience, salary required, etc., to Box PM623, FOUNDRY TRADE JOURNAL.

SITUATIONS VACANT—*contd.*

WORKS ENGINEER required for expanding Foundry in Glasgow area. Must be experienced in the design and layout of foundry plant, and capable of taking general control of maintenance. This is a permanent position, and will carry membership of a superannuation scheme.—Particulars of experience and present salary in confidence to Box WE645, FOUNDRY TRADE JOURNAL.

APPLICATIONS invited from fully skilled IRON AND NON-FERROUS MOULDERS for a Foundry on the South Coast. Good basic pay with pension and profit sharing schemes in operation.—Write, giving full details, to Box AI644, FOUNDRY TRADE JOURNAL.

SALES OFFICE ESTIMATOR required for Steelfoundry.—Apply in writing, giving full details of experience, etc., Box SO643, FOUNDRY TRADE JOURNAL.

MELTING SHOP FOREMAN required for Steel Foundry producing high alloy steels. Wide experience on small Arc Furnaces essential, and some knowledge of H/F. melting would be an advantage. Permanent, progressive position, with housing accommodation if required.—Write, stating age, experience, and salary required, to PERSONNEL OFFICER, Sheepbridge Alloy Castings, Ltd., Hamilton Road, Sutton-in-Ashfield, Notts.

MECHANIC required, with experience of "B.M.M." moulding machines, to service an installation of 32 Turnover and Straight draw type machines in a South African Foundry.—Replies to Box MR614, FOUNDRY TRADE JOURNAL.

FOREMAN/MANAGER required for Light Grey Iron Foundry, to take charge of Cupola and Moulding Shop. Black Country area. Give details of experience and salary required. All replies treated in strict confidence.—Box FM615, FOUNDRY TRADE JOURNAL.

GRAVITY DIE FOUNDRY (Aluminium) in Midlands requires SHOP MANAGER. Must be practical man, capable of taking full charge of labour and production; age 30/40. Four-figure salary for the right man.—Box GD616, FOUNDRY TRADE JOURNAL.

JOBBING MOULDERS required, London shop; also CUPOLA FURNACEMAN.—Apply PLANT, MACHINERY & ACCESSORIES, LTD., 136/140, Bramley Road, W.10.

A MIDLAND Mechanised Malleable Foundry requires PRODUCTION/METHODS ENGINEER. High salary offered for the right man. Superannuation scheme in operation.—Write, stating experience and salary required, Box AM618, FOUNDRY TRADE JOURNAL.

FIRST-CLASS skilled PATTERNMAKER required. Experienced in wood and metal. Average wages of 44-hour week between £10 and £11.—Apply WELLWORTHY, LTD., Lymington, Hants.

A TECHNICAL SALES REPRESENTATIVE required for the sale and servicing of Shell Moulding Equipment. Should have a pleasant Sales personality and a good foundry background, preferably with Shell Moulding experience. Preference given to active I.B.F. member. Please state in confidence in first letter fullest history, age, etc., and territory preferred.—Box AT619, FOUNDRY TRADE JOURNAL.

SITUATIONS VACANT—*contd.*

FOUNDRY ESTIMATOR, in South Birmingham. Experienced in weight estimation and cost extensions. Must be fast, accurate worker. Good wage offered.—Box FE636, FOUNDRY TRADE JOURNAL.

FOUNDRYMAN / METALLURGIST, with theoretical knowledge and practical experience in aluminium and copper-base alloy foundry physics. Keen man, to cover experimental and routine control work. South Birmingham area.—Box FM637, FOUNDRY TRADE JOURNAL.

FOUNDRY CHIEF INSPECTOR for Light-Alloy Gravity Die and Sand Foundry in South Birmingham. Good engineering background and working knowledge of quality control essential. Approved A.I.D. and other authorities.—Box FC638, FOUNDRY TRADE JOURNAL.

ASSISTANT PRODUCTION MANAGER required, age about 28-30. Apply in writing, stating full details of previous experience and salary required.—All applications will be treated in strict confidence, and should be addressed to GENERAL WORKS MANAGER, Bradley & Foster, Ltd., Darlaston, South Staffs.

TECHNICAL ASSISTANT.—An expanding Foundry in the North-East, producing Non-ferrous (principally Aluminium Alloy) sand, shell, and gravity die castings, has a vacancy for a Technical Assistant, with sound Foundry Drawing experience, educated to H.N.C. standard, and preferably with some foundry experience. Salary according to ability and previous experience, with excellent prospects of promotion to Foundry Manager. Housing assistance if required.—Reply, giving full details of career to date, age, etc., to:—MANAGING DIRECTOR, Daralum Castings, Ltd., Longfield Road, Darlington.

PATTERNMAKERS, experienced in both wood and metal, wanted in Birmingham and Manchester by the world's largest engineering master patternmakers. Must be accustomed to highest standards and accuracy, and prepared to work overtime. Ideal conditions, top remuneration.—Write full particulars of experience to Head Office, WRIGHT & PLATT, LTD., Irving Street, Birmingham, 15.

ARE you at a dead end? Could you earn more if given the opportunity to do a larger job? Have you or could you develop the ability to sell not goods but ideas? If so, please communicate with the advertisers, who plan to expand their activities and to increase their sales force. The positions offered are well paid and pensionable, and could lead to Management. Full training is given.—Write in confidence, giving experience and full particulars, to Box AY607, FOUNDRY TRADE JOURNAL.

FOUNDRY MANAGER required for Malleable Iron Foundry in Home Counties. Age 33 to 45. Salary £1,000, and pension scheme. House with garage available at nominal rent.—Apply, giving full history of education, posts held, technical and managerial experience, to Box FM609, FOUNDRY TRADE JOURNAL.

SKILLED NON-FERROUS MOULDERS required. Light and medium, dry and green sand-work. Top rates of pay and piecework. Permanent employment with an old-established firm in Yorkshire. Accommodation found for single men.—Write Box 9906, C.P.P., 35, Morley Street, Bradford.